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AVIATION

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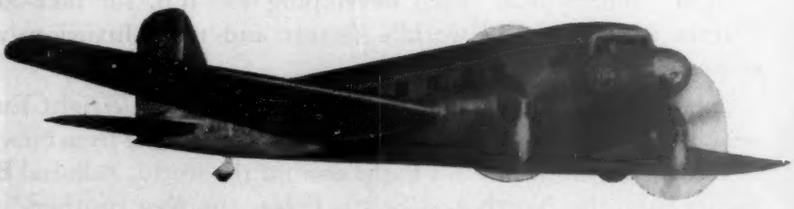

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A New High Record of *14 Miles*

Stratosphere Balloon Fabrics Furnished by Wellington Sears Co.

The Goodyear Zeppelin Corporation, Akron, Ohio, constructed the bag of the stratosphere balloon used in the recent successful flight made by Captains Albert W. Stevens and Orvil A. Anderson under the auspices of the National Geographic Society and the U. S. Army Air Corps from fabrics secured chiefly from Wellington Sears Company.

In their construction of this record-breaking balloon they used three fabrics—distributed according to accurately calculated determination of the stresses to be met. The characteristics of these Wellington Sears fabrics are shown below:

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B. B.	104 x 104	3 oz.	60 lbs. per in.
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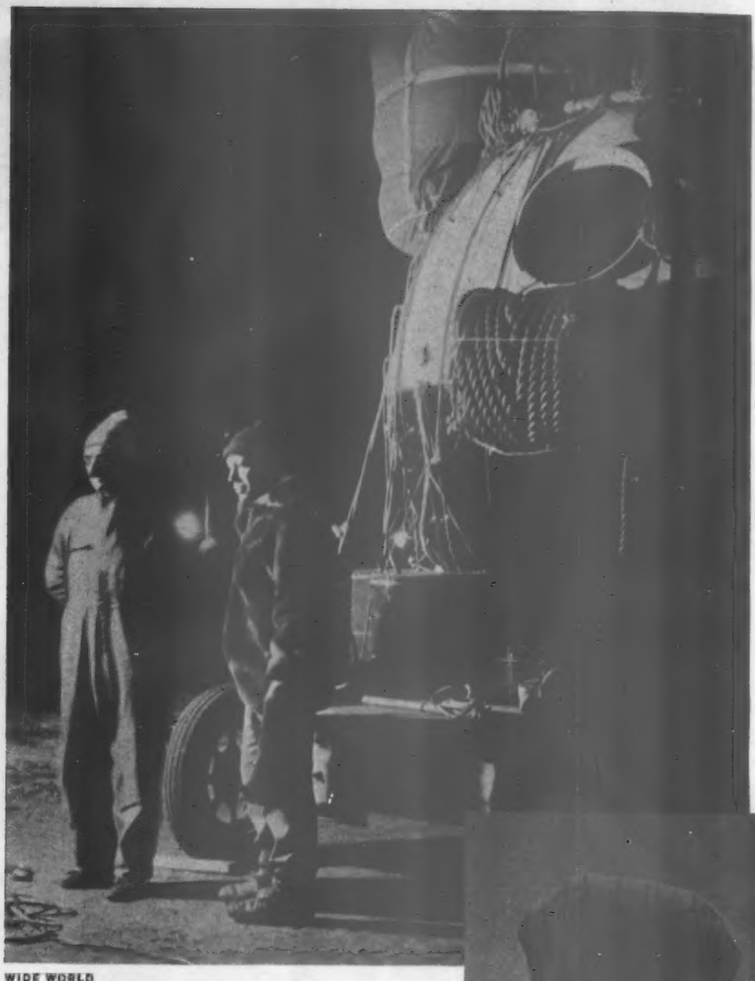

WIDE WORLD

Capt. Albert W. Stevens and Capt. Orvil A. Anderson, Commander and Pilot respectively of the stratosphere balloon, warmly attired as they stand in front of their gondola just before taking off on their record-making flight.

These aeronautical fabrics have also been used this year on the record-breaking plane of Howard Hughes of California, on Benny Howard's "Mister Mulligan," winner of the Bendix and Thompson Trophies at the National Air Races; on the "Ole Miss," holder of the record for greatest time aloft—653 hours, 34 minutes, and on the Cessna C-34 Airplane which was judged the most efficient plane in the world at the National Air Races.

These records for these fabrics speak for themselves.

WIDE WORLD

The stratosphere balloon in which Capt. Albert W. Stevens, Flight Commander, and Capt. Orvil A. Anderson, the Pilot, soared to a height of 14 miles to set a new world's stratosphere record.

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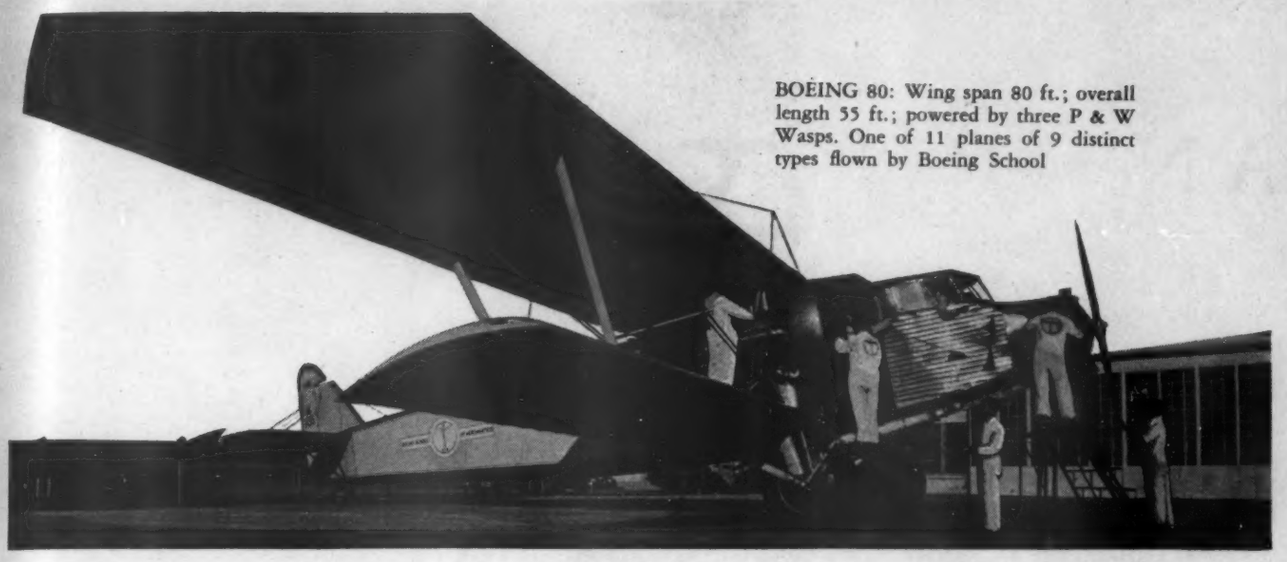

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New Wings for a New Germany

By Edmund T. Allen
Consulting Aeronautical Engineer

Courtesy Luftwelt

First steps. The building and flying of model sailplanes is an invaluable experience for future pilots.

Edmund T. Allen

The author recently delivered a paper on transport cruising control before the V.L.F., Germany's No. 1 aero-scientific body. During his visit he was given unusual opportunity to see something of the rebirth of German aviation. We count it a rare privilege to be able to publish for the first time in the United States an eye-witness account of Germany re-arming herself in the air. This is the first of several articles.

IMAGINE, if you can, our own Air Corps, our entire Naval Air Service, and the Bureau of Air Commerce rolled into one and multiplied many-fold, and you have a picture of Germany's unified Air Ministry. Imagine Wright Field, the Naval Aircraft factory, the National Advisory Committee for Aeronautics, and the Bureau of Standards consolidated and you have something like the present German D.V.L. (Deutsche Versuchsanstalt für Luftfahrt). Imagine, finally, a sort of super-Institute of the Aeronautical Sciences, with technical subcommittees headed up by the best known aeronautical names in the country, not only performing its own research and development in every line of aeronautical activity, but coordinating all other agencies, acting as a clearing house for development work, alloting funds for specific research projects to any agency that seems best equipped for it, eliminating duplication of efforts in all departments, and you have some conception of the enormous Vereinigung für Luftfahrtforschung (formed two years ago by Air Minister Hermann Goering), popularly known as the V.L.F.

Back up this vast system of a dominating bureaucracy with an unbelievable enthusiasm for matters aeronautical shared by the military and the civil population alike, and you have some idea of what aviation has come to mean to the New Germany. There, things are coming true which might seem to us in America as the dreams of a distant future. Nothing seems impossible to Germany's aviation planners. All differences have been swept aside and all factions have been united. Germany now has an Air Ministry as efficiency centralized as Mussolini's own, but made more efficient, perhaps, by Prussian genius for organization and Teutonic capacity for taking infinite pains over the smallest detail. We find a public suddenly awakened to the future of aviation, suddenly determined to build a new and greater nation of flying men and air-borne commerce.

The traveler returning to the United States to report on conditions observed in countries overseas about which great controversies exist, must be prepared to accept all sorts of labels. He will be stamped immediately as a communist or as a red-baiter, or as dupe who saw only what he was supposed to see, or else as one whose preconceived notions made

it impossible for him to see anything else but the things that he wanted to see. I shall have to risk that sort of thing in describing what I saw in my visit to Germany in October this year.

Although economic recovery may be more apparent than real in Germany, certainly it makes a profound impression upon one who is accustomed to see blocks of unoccupied stores in Chicago or abandoned factories in Los Angeles. One has to look long for vacancies in Berlin and for abandoned properties in South Germany. Unemployment is on the wane (1,600,000 are the official figures for 1935 as compared with 6,000,000 in 1932) but wages are extremely small. One hears, even among the unemployed, talk of opportunities for sacrifice rather than of rights, apparently without sarcasm. Quite likely the laborer's willingness to work hard for the barest living rises from his belief that everyone is doing it and that the government has exacted equal sacrifices from the wealthy. To my surprise, however, I did not hear the wealthy complaining of their tax burdens. Compared with my recollection of the Germany of 1922 and 1923, with its collapsed monetary structure, and my more vivid memories of the despair in the Germany of 1929, Germany in 1935 appears on the surface, at least, to be a land of paradise—not of dreams but of their fulfillment. Farms, factories, and schools are buzzing with activity. Airlines are heavy with traffic and the railroads are carrying capacity loads. As far as the aircraft industry is concerned, anyone with the slightest aircraft experience has several jobs open to him, although, of course, the pay is small.

Wide World

Second stage. From model flying to soaring full scale is an easy step. Here seven of the standardized sailplanes have taken-off in formation from a glider camp during a recent display by the German Aerial Sport Union.

The new defense

In order to appreciate the feelings of the average citizens toward the aviation activities of Hitler's government, it is necessary to understand thoroughly that in Germany the Air Corps is not an adjunct of the army or of the navy, but is in fact the first line of defense. To be an officer in the Air Corps is among the greatest honors for which one may aspire in Germany. It carries more prestige than wealth or than social position. To the air defense of the nation appropriations are made with enthusiasm, contrasting strangely with the reluctance with which funds are made available to the air arms of our own army and navy. Even the laborer contributes his heavy income tax, no matter how small his wage, with the light of faith in his eyes, contributing to the "cause," to make Germany first in the air. This is an achievement in social psychology quite without precedent in modern times. Thus the man in the street points proudly to the new Air Ministry building now rising in the center of Berlin, seeing in it a symbol of safety which the Versailles treaty never gave him.

Aeronautical education begins with the very young. The Air Ministry sees to it that aviation consciousness is fostered even in the lowest grades by distributing a weekly periodical devoted solely to aviation to all teachers. It is intended to help them answer accurately the questions put to them by their students, and also outlines general talks on aviation for classroom use. Departments are assigned to model building, to gliding and soaring and to the new heroes of the air in sport, in transport, and in the Air Corps. The idea is fostered that the modern student is indeed fortunate to have been born into a new world of the air. This is the keynote from kindergarten up. Model-making begins at an early age and progresses from the manufacture of the simplest types through a detailed study and reproduction of the products of the German factories and also of foreign types. German students turn out jobs which are marvelous for accuracy of detail and for high finish. In this way they absorb their aerodynamics subconsciously at a very early age. An important part of the model program is the design and building of model gliders. Model gliding meets are held which reproduce the appearance and the conditions of the full-scale glider camps.

The glider camps

To boys of primary school age is opened up the prospect of spending a summer in one of the many glider schools now established in Germany. The courses are generally similar to those used in this country, with three grades leading up to the finished soaring pilot. The course for each of the three grade requires four weeks of study and of flying, as well as glider repair, design and construction. A typical mountain soaring camp is the one at Hornberg near Stuttgart. In this camp alone 120 students are enrolled each month. Here are to be found modern dormitories, swimming pool, mess-halls, classrooms, repair shops and hangars. Here also is a glider factory. In each of the hangars we estimated that there were 50 sail planes of the latest standardized type.

In Germany there has been a reaction away from the enormous wing spread of the sailplanes of a few years ago. The machine with a hundred foot cantilever wing whose tips dropped to the ground under its own weight has given way to a few standardized designs in which utility, ease of dissembly and transport, and cheapness of construction and repair have had some consideration. The usual span is approximately 65 ft. Two principal types are in evidence, almost equally divided between ships with full cantilever wings and those with some strut bracing. The full cantilever types are usually of gull form, with a short dihedral wing root coming up out of the side of the fuselage and then curving strongly downward, tapering to the tips. In the air the outer portions of the wing are approximately horizontal. In the other types, the wing is built straight and attached well above the fuselage to keep the tips from dragging when on the ground. Short struts on each side stiffen the wing attachment.

All sailplanes are fitted with a standardized type of single landing skid, well streamlined into the body, and the finish of surfaces is up to the best sailplane tradition. The pyralin pilot enclosure on these models usually leaves nothing to be desired aerodynamically. It is therefore a bit incongruous to see large airspeed pitots and turn indicator venturis stuck out into the airstream.

It is quite an inspiring sight to see 50 such perfect specimens lined up with wings overlapping awaiting their turn at the winch. Winch towing, by the way, has almost entirely replaced the former practice of automobile or airplane towing-off. In many places it is now preferred to the old method of hand launching even at sites where favorable winds prevail. In a later article something will be said of the winch equipment and the technique. Suffice to say here that it is one of the improvements that has helped put German glider pilot training in a new category, both as to time and expense.

At Hornberg, as at all other glider camps, the course is under the direction of the military authorities. A commandant, a chief flying instructor and many assistant instructors are assigned to the camp. Students are inducted from lower to higher pilot grades in ceremonies that are almost religious in character.

Blind flying is required of all glider pilots completing the highest grade. Turn and bank indicators are installed in all the final stage sailplanes. Since in-cloud soaring is by its very nature blind flying, a great deal of practice in instrument flying and in blind navigation is thus obtained.

I asked one of the gliding instructors at Hornberg whether or not the glider course decreases the time required for Air Corps flight training in powered ships. He pointed out that in a course in flying requiring 200 hours to complete, about six hours only is dual. If preliminary soaring instruction made possible a reduction of the dual time by as much as 50 per cent, it would make only a difference of 1½ per cent in the total. I asked further whether a pilot who could successfully fly a sailplane at its absolute ceiling for a long period of time would not be able to arrive at the 200-hour stage in powered flying in about 100 hours. The reply to that was that while it might be true, most of the glider pilots did not attain such a high degree of proficiency in the training schools. The sailplane pilots who make the remarkable cloud-hopping flights, hitch-hiking onto thermic currents, are almost without exception advanced soaring students with more than the usual three months' training given in the pre-Air Corps gliding courses.

Soaring economics

The principal contribution of the soaring school experience to pilot training is said to be the economical elimination of students temperamentally unsuited for flying of any kind. Without the preliminary soaring school, it might be possible to train 100 pilots out of 300 applicants at an average cost of $10,000 per applicant or $30,000 per graduate. The soaring school, on the other hand, with extremely low operating cost and low overhead, might easily be expected to disclose and to eliminate those unfit for flying at a fraction of this figure. Taking a hypothetical 300 applicants or 100 graduates, the final cost might approximate $12,000 per graduate instead of the original $30,000.

According to the best figures available, there seems to be a training capacity of between 3,000 and 5,000 glider pilots per year in all the German glider schools. This figure probably does not include those graduating from soaring schools and entering power flight training, but rather covers the original number of applicants, some of whom are to be eliminated during training. All those not weeded out during the soaring training are given an opportunity after graduation for entering a power flight school.

Over 2,500 pilots a year

Soaring training is not, however, a prerequisite for power flying. As many new flying students are taken directly into motor flight units as through the soaring grades. The training centers for the Air Corps are scattered throughout Germany. The courses of training are quite similar to ours but at present are being condensed and accelerated owing to the executive order that pilots must be available immediately to man the ever-increasing flood of new aircraft now issuing from German factories. As will be pointed out in a later article, an estimate of the production rate of aircraft in Germany today sets the figure at between 3,000-4,000 units per year, practically, all of military types. Pilot training rates, of course, lag somewhat behind this figure, but it seems safe to estimate that the flying schools of Germany are turning out trained pilot personnel at the rate of 2,500 to 3,000 men per year. These are the pick of Germany's youth. These are the nucleus for the new German air power.

Mr. Allen will continue his discussion of aviation in Germany in an early issue.

Acme

Power flight, the goal of the model-builder and soaring student. A group of Klemms about to leave Berlin's Tempelhof for the 1935 Rundflug.

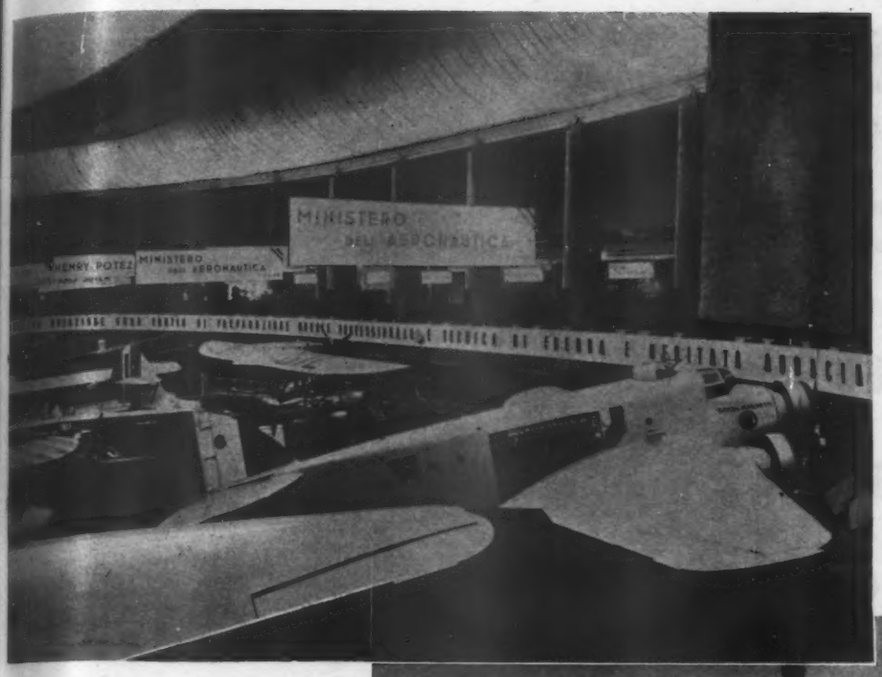
Show in Milan

In spite of diplomatic complications abroad, Italy opened her first International Aircraft Salon on schedule. Germany, France, Russia, Italy were conspicuously present,—Great Britain conspicuously absent.

Close-up of the Italian exhibits. In the foreground the latest Savoia Marchetti bomber. Behind it, a couple of world record breakers, including the 440-m.p.h. Macchi 72 and its double Fiat 2,800 hp. engine, also the CANT Z-501 flying boat, recent holder of the world's distance record.

An Italian four-place touring machine, the CNA-25. The curved windshield is notable. Two large doors on each side give easy cabin access.

Right: Russian light transport, the Stal-3 for six people and pilot. Entire structure is of electrically-welded steel.



Transports, bombers, racers, sportsters, and gliders indicate the general trend of European design in this general view of the Milan show.

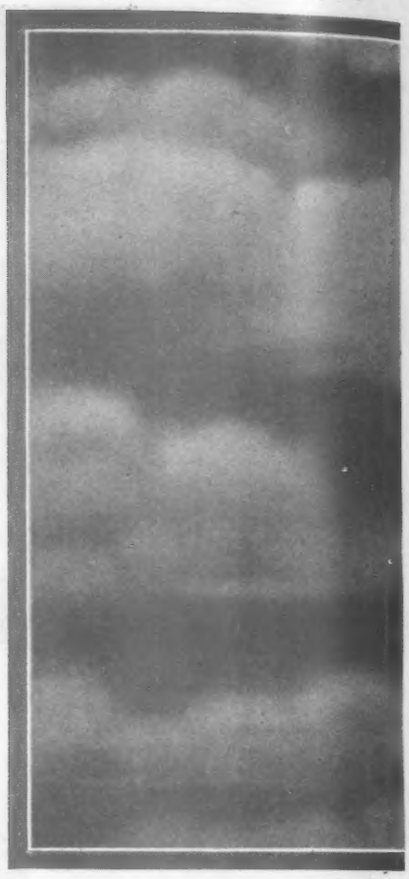
This unusual tail group treatment belongs to the German Focke-Wulf 56, single-seat high-wing training monoplane.

Below: The Fiat group included a single-seat pursuit ship powered with liquid-cooled engine (right) and one with a twin-row air-cooled radial (left). Note the Hamilton-Standard controllable pitch propeller in the center of the exhibit.

Caproni of Milan exhibited a wide range of products, from the single engine touring type on the extreme left to the large twin-engine transport, the Model 123. Two fourteen-cylinder Gnome-Rhone engines furnish the power.

A Russian single-seat monoplane with 700 hp. which is reported to have a top speed of about 250 m.p.h. at 16,000 ft.

In emergencies, the human mind is most likely to act according to its earliest training. If a pilot has been taught to fly by instruments from the beginning, he will rely on instruments instinctively when the weather closes in.



Instrument Training from Scratch

By T. Lee, Jr.
Manager,
Boeing School of Aeronautics

ONLY one glimpse of the ground in his first 23 hours of flight instruction is the unique experience of one Boeing school student. Raymond Schwarz is beyond doubt the first airplane pilot in the world to be trained in instrument flying from the very beginning of his career. His single fleeting glimpse of the earth below was accidental and occurred when the latch on the hood of his training plane was inadvertently tripped.

Schwarz, a Boeing scholarship winner, started his flight training "from scratch," under the hood. After six hours of instruction on a Boeing 203 trainer he had made such remarkable progress in flying by instrument alone that we turned on the radio and started giving him instruction on the beam. In fifteen hours and 30 minutes of instrument and beam instruction, he was capable of locating himself and finding the cone of silence; in fact, was fully capable of flying the beam. We then transferred him to a Boeing 40, (5,000 lb. 425 hp.) and he made such progress that on his second flight we asked one of the chief pilots of United Air Lines to fly with him. As in the lighter ship, he did an excellent job, easily locating the beam, finding the cone of silence, and locating himself over Oakland Airport. After 7 hours and 37 minutes of instrument flying in the 40, we decided to put him in the open cockpit, and solo him. He soloed in three hours and 55 minutes. Twenty-seven hours may seem a long time to take to solo at first sight, but when that period of dual includes such accomplishments as complete familiarity with instrument flying methods, and an ability to find one's way around on the radio beam, it is exceptionally short.

Schwarz continued his flying until he had 30 hours, with two hours and nine minutes solo. We were then anxious to see what he would do if put back under the hood, so we asked Mr. Lott, in charge of the flying of United Air Lines, to fly with him. Schwarz took off under the hooded cockpit with Mr. Lott as safety pilot, climbed to 3,000 ft., accomplished a 360 deg. turn to right and left, and went through certain demonstrations of the work before the radio was turned on. He then located the beam, found the cone of silence, flew out on the San Francisco beam, turned around and came back on the beam, losing altitude to 1,000 ft., and again located the cone of silence. From the cone, he dead reckoned by compass and time for one minute and fifteen seconds, executed a 180 deg. turn, losing altitude to 500 ft. in the turn, and then made a stab at landing at Oakland Airport. During all this time, Lott had not touched the controls. Coming into the approach, he was a few feet short, and possibly would have landed the plane just on the edge of the field, so Mr. Lott opened the throttle a little, closed it, and Schwarz proceeded to come in and bring the plane down to a landing.

The method used in the instruction of Schwarz and others is likely to revolutionize our teaching at the Boeing School. For a long time we have believed that instrument training should be a forethought rather than an afterthought. We have gathered ample evidence that beginning impressions are more lasting than those experienced subsequently and that, in times of extreme mental stress, one is most likely to act in accord with his early teaching.

Shortly after beginning the experiment with Ray Schwarz, we started two other students, and two months later, we started six additional students in this type of instruction. The second man, also a W. E. Boeing Scholarship winner, had two years of training at the University of California, in the College of Fine Arts. He did not have a technical background nor did he have any real practical experience or knowledge of instruments, and we were interested to see his reaction to this type of flying instruction. We find that he has learned to fly by instrument and radio just as well as our first student.

We find difficulty with the average student in getting him to enlarge his imagination to take into account each instrument separately as well as to interpret the readings in relation to the readings of other instruments. It is our belief that

No iron compass could be used by Raymond Schwarz whose first 23 hours were flown without seeing the ground.

From England to San Francisco came three Royal Air Force officers to study instrument flying methods. Left to right: George I. Myers (Boeing School); Squadron Leader G. S. Oddie, Capt. H. G. Smart, Flt.-Lieut. D. H. F. Barnett, Leroy B. Gregg (Boeing School).

during twenty hours of instrument flight instruction, we can come nearer to evaluating the mental caliber of a student than we can in several times that number of hours' training in the conventional order of flight instruction. We have found some students who, under the old method of learning to fly, would solo and come to a certain stage of training during the 20 or 30 hours, and then not be able to progress beyond that point. In nearly every case it has been lack of imagination, and mental lag. Instrument and radio flying under the hooded cockpit at first will enable us to discover quickly whether a man has the necessary mental equipment to become a good bad-weather pilot.

In February, 1935, issue of AVIATION, an article "Under the Hood," by Messrs. Myers and Kaster, of the Boeing School awakened the interest of the military authorities in England and led to correspondence with the British Air Attaché at Washington. This correspondence dealt not only with instrument and radio flying, but also the experiments we planned in giving blind flight instruction from scratch. As a consequence the Royal Air Force sent to the Boeing School Group Capt. H. G. Smart, Squadron Leader G. S. Oddie, and Flight Lieutenant D. H. F. Barnett, to make a detailed analysis of the instrument and beam flight instruction and particularly to see what was being done with instrument radio beam flying under the hooded cockpit for beginning students. These three officers have now completed their investigation and have returned to England with their findings.

In the class beginning Sept. 30, 1935, we equipped another primary training ship for instrument flying under the hood and started seven more beginning students in this method. We are now so completely sold that we believe all students taking instruction for long-time courses, such as our Airline Pilot course (250 hours) should begin their flight instruction with instruments under the hood.

Beginning impressions are usually the lasting impressions. By starting a man in "blind" we try to condition him so that in times of stress his reactions will be sound. Such a man should make the best kind of bad-weather pilot.

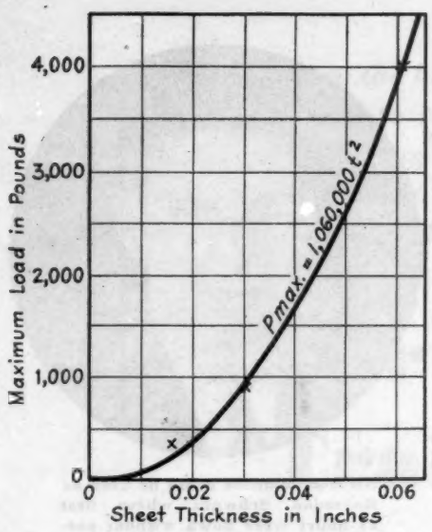


Fig. 1. Compressive strength of flat sheets of aluminum alloy (17 ST).

Skin Deep

The second of two articles on the allowable stresses in stressed-skin structures

By Joseph S. Newell

Associate Professor of Aeronautical Engineering, Massachusetts Institute of Technology

AS WAS SHOWN by Bureau of Standards tests, the load carried by flat sheets having vee-groove edge supports varies with the sheet thickness but is essentially constant for all widths and lengths so long as the sheets are flat. The tests showed that the maximum load for sheets could be predicted quite closely by the use of a formula of the type

$$P = A\,t^2,$$

where P was the maximum load, A a constant and t the thickness of the sheet. Kármán, Sechler and Donnell in their paper "The Strength of Thin Plates in Compression" (Transactions of the Applied Mechanics Section, A.S.M.E. January 1932) presented a rationalized formula

$$P = C\,t^2\sqrt{E\,p_y}$$

where P is again the maximum load which the sheet will sustain; C is essentially constant; t the sheet thickness; E the modulus of elasticity of the material; p_y the yield point strength. For aluminum alloy sheets (17*ST*) it has been found that $C = 1.73$, $E = 10{,}000{,}000$ and $p_y = 36{,}000$ are good values to use in this formula which then simplifies to

$$P = 1{,}060{,}000\,t^2$$

Fig. 1 is a plot of this expression and the points marked "x" represent the values obtained by the Bureau of Standards tests.

Figures 2 and 3 are purely empirical and give the two factors, K_1 and K_2, by which the maximum load on a flat sheet may be multiplied to give the maximum on a curved sheet. They were developed from the test data obtained at the Massachusetts Institute of Technology on curved sheets of aluminum alloy of various widths, lengths and thicknesses. All were supported between vee-grooves and all were precurved to the radius desired before being put into the testing machine. Widths of 3, 6, 9, and 12 in., lengths of 6, 12, and 18 in. and thicknesses of 0.019, 0.032 and 0.052 in. were tested in radii of 5, 10, 20, 30 and some of 80 in., as part of the program to obtain data on curved sheets in compression. It has been found by checking against other available test results that the length factor, K_2, can be plotted for radii up to 24 in. and still give satisfactory results. It has also been

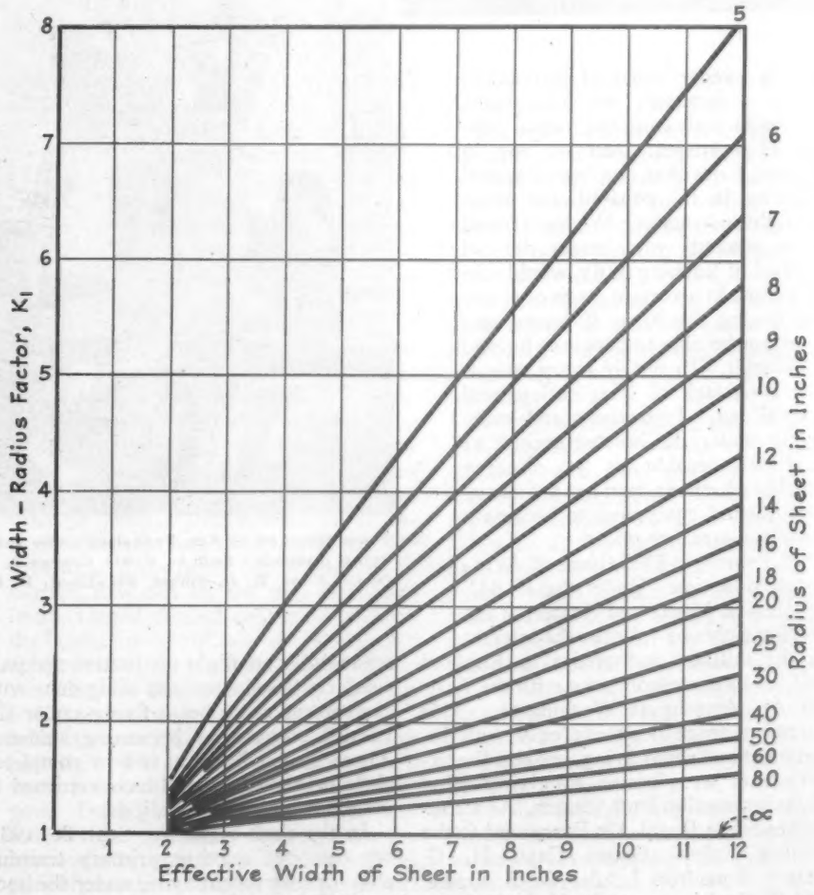


Fig. 2. Width-radius factor, K_1

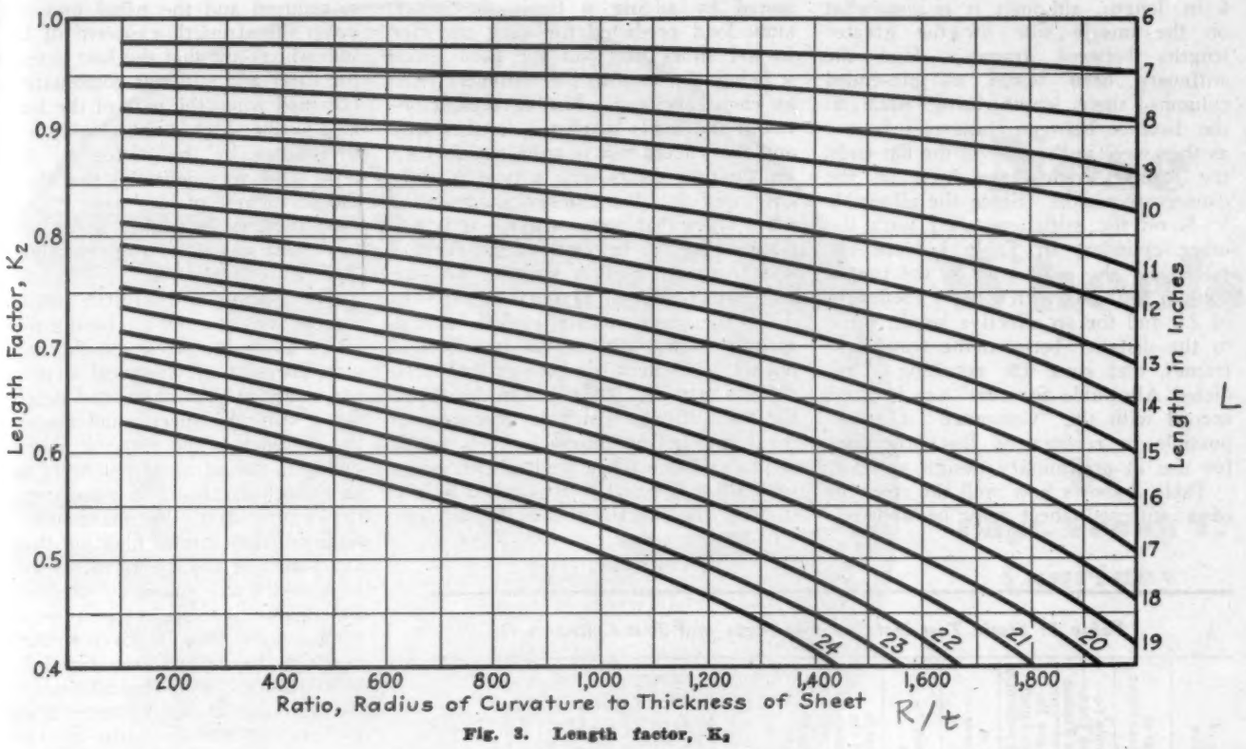


Fig. 3. Length factor, K_2

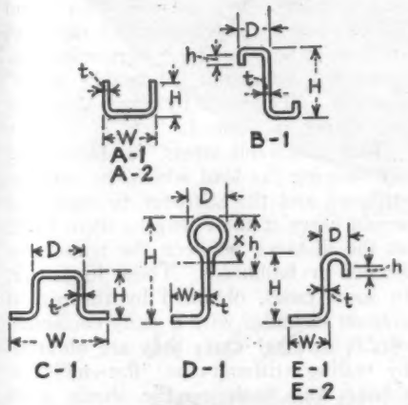


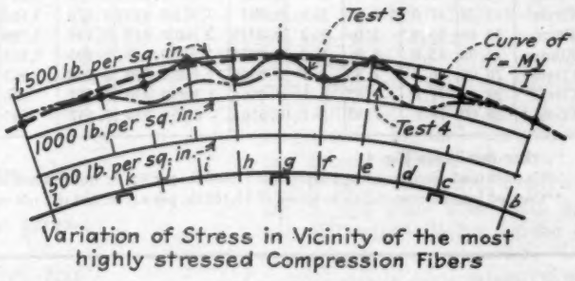
Fig. 4. Types and dimensions of stiffeners studied.

Type	t	D	H	h	W	Area
A — 1	0.035	.....	0.500	.....	0.750	0.0566
A — 2	0.082	.....	0.870	.....	1.500	0.2405
B — 1	0.024	0.480	1.250	0.200	.....	0.0650
C — 1	0.025	0.675	0.675	.....	1.500	0.0643
D — 1	0.060	.....	0.5625	.....	0.875	0.1085
E — 1	0.025	0.350	0.930	0.188	0.500	0.0388
E — 2	0.045	0.385	1.125	0.125	0.438	0.0935

found that the values of K_2 for the ratio of radius to thickness of 2,000 can be used for ratios in excess of 2,000.

Fig. 2 needs no explanation beyond the fact that the effective width of a stiffened sheet is the distance measured around the arc between the lines of rivets on adjacent stiffeners. Where a stiffener is attached by two rows of rivets, as might be the case with the type C-1 stiffener of Fig. 4, the best practice seems to be to consider the portion of the sheet in immediate contact with the stiffener to be part of the stiffener. If tests are made to determine the strength of the stiffener they can be made with this portion of the sheet attached and the load carried can be considered as the "load on the stiffener." For unstiffened sheets the effective width is, of course, the distance between vee-grooved edge supports.

If the "load on the stiffener" is to be determined by test it may be done by testing the stiffener as a column having flat ends. This is shown by the results on the three 20 in. radius circular cylinders in Table 1 where the allowable stress which is based on flat end stiffener tests is slightly less than the computed when the transverse frames are 6 in. apart—somewhat greater than that computed for the 12 in. spacing, and greater for the 18 in. A definite conclusion cannot be drawn on the basis of three tests but it appears reasonable to say that the flat-end condition is approximately correct for the



Variation of Stress in Vicinity of the most highly stressed Compression Fibers

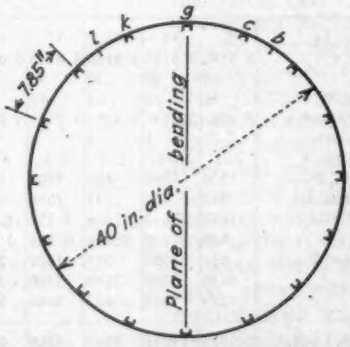


Fig. 5. Huggenberger strain gage data for a portion of a cross section of a circular cylinder 40 in. in diameter and 15 ft. long.

At Test Section

Bending moment	50,000 in. lb.	Thickness of skin	0.020 in.
Shear (Test 3)	660 lb.	Bulkhead spacing	12 in.
Shear (Test 4)	0 lb.	Stiffener spacing	7.85 in

6 in. length, although it is somewhat on the unsafe side for the greater lengths between frames. Had the stiffeners been tested as pin-ended columns, their length being equal to the distance between transverse frames as they were in the case of the flat-ends, the results would have been on the conservative side. Since the allowable loads on the stiffeners used with the other cylinders in Table 1 were obtained for the most part by the use of column formulas with a fixity coefficient of 2.0 and for an effective length equal to the distance between the transverse frames, and since the resulting "Predicted Allowable Stresses" are in good accord with the "Computed" it seems possible to recommend this procedure for use in preliminary design at least.

Table 2 shows how well the strength of a stiffened sheet may be approximated by adding n times the maximum load predicted for each stiffener to n-1 times the load for each sheet, n being the number of stiffeners used on each specimen. The agreement between the loads predicted in this way and those from test is quite satisfactory for the thin sheets with a type A stiffener and for the thicker sheets with other types that were stiffer. It is not good where the heavy 0.052 in. sheet is used with the type A stiffener because the light stiffener is not sufficient to make the sheet remain smooth in the vicinity of the stiffener so its effect is not the equivalent of a vee-groove. No definite criterion has yet been developed for the stiffness which is necessary to break a panel up into n-1 sheets but it can be said that when the load carried by each sheet is equal to that taken by the stiffener the effectiveness of the stiffener is reduced and the panel may not develop the strength expected of it. The indications are that the best proportions for sheet and stiffener combinations are obtained when the part of the load carried by the sheet is appreciably less than that taken by the stiffeners. In fact, tests show very definitely that the larger the percentage of total area is placed in the stiffeners the higher is the strength-to-weight ratio of a given sheet and stiffener combination.

Fig. 5 presents what little justification may be said to exist for basing the computed allowable stress on the compression fibers of a cylindrical structure on the stress at maximum load determined for a stiffened sheet panel made up of the stiffener at the extreme fiber of the cylinder, the adjacent stiffeners and the sheet between them. It is apparent from the figure that the maximum stress occurs at the extreme fiber but that there are points in the sheets in the adjacent bays which are subjected to stresses of practically the same magnitude so that some weight must be given to the areas in which they occur. Investigations have been made as to the desirability of using the stiffener at the extreme fiber plus various "effective" widths of sheet, the extreme stiffener plus the two to either side and the sheet between them, and various other combinations of skin and stiffeners, but the best agreement between the computed "allowable stress" and the value given by $f = M\ y/I$ is that shown in Table 1.

This "allowable stress" is obtained by determining the load which the extreme stiffener and the stiffener to each side would carry if their lengths were taken as the distance between the transverse frames or bulkheads. These loads are, in some cases, obtained by the use of column formulas with a fixity coefficient of 2.0, in other cases they are obtained by testing stiffeners as "flat-end" columns. The loads on the sheets were determined by the use of Fig. 1, 2 and 3 and since there are two "effective" sheets and three stiffeners in the critical panel, simple addition sufficed to give the load which the panel would carry. Dividing that load by the combined areas of the two sheets and three stiffeners resulted in an average stress for the panel and it is this average stress which is listed as the "Predicted Allowable Stress" in Table 1.

A comparison of these stresses with those given as "Stress at Failure from $f = M\ y/I$" is interesting. The results are in unexpectedly close accord and while they do not provide for the effects of double curvature of the skin, or for the effect of bending combined with shear due to torsion on a wing or fuselage, they do seem to indicate that a simple method may eventually be evolved for the design of stressed skin structures as our knowledge of their behavior increases.

Table 1: Static Test Data on Fuselages and Test Cylinders

Shape of Section	Radius at Critical Point	Distance Between Transverse Frames	Distance Between Longitud'l Stiffeners	Type of Stiffener †	Stiffener Area	Allowable Load On Stiffener	Thickness of Skin	Area of Effective Sheet	Allowable Load On Sheet	Predicted Load for 3 Stiffs + 2 Sheets	Total Area of 3 Stiffs + 2 Sheets	Predicted Allowable Stress	Stress Computed from f = My/I
Ellipse	8	14.7	4.0	E-1	0.033	720	0.025	0.100	1,280	4,720	0.299	15,800	15,670
Ellipse	8	14.7	5.5	E-1	0.033	720	0.025	0.1375	1,635	5,430	0.374	14,500	12,300
Circle	15.28	24.0	6.0	B-1	0.067	1,290	0.0294	0.176	2,420	6,290	0.553	11,400	12,070
Circle	15.28	24.0	6.0	B-1	0.067	1,290	0.0293	0.175	2,410	6,270	0.552	11,400	12,865
Circle	15.28	17.0	6.0	B-1	0.067	1,315	0.0204	0.122	1,360	5,305	0.445	11,900	11,740
Circle	15.28	17.0	6.0	B-1	0.067	1,315	0.0204	0.122	1,360	5,305	0.445	11,900	12,460
Circle	15.28	17.0	6.0	B-1	0.067	1,315	0.0293	0.176	3,100	7,045	0.553	12,700	12,165
Circle	15.28	17.0	6.0	B-1	0.067	1,315	0.0293	0.176	3,100	7,045	0.553	12,700	12,235
Ellipse	15.00	13.0	5.0	E-2	0.0935	2,260	0.029	0.145	1,500	9,780	0.570	17,100	*
Ellipse	12.00	13.0	8.9	E-2	0.0935	2,260	0.023	0.205	1,565	9,910	0.796	12,400	**
Circle	20.00	6.0	7.85	A-1	0.0566	1,550	0.020	0.157	965	6,680	0.485	13,650	14,000
Circle	20.00	12.0	7.85	A-1	0.0566	1,300	0.020	0.157	800	5,500	0.485	11,300	10,300
Circle	20.00	18.0	7.85	A-1	0.0566	880	0.020	0.157	645	3,930	0.485	8,100	7,690

†For details see Fig. 4.

*Carried load corresponding to stress of 15,600 lb. per sq. in. but did not carry 16,400 lb. per sq. in.

**Carried load corresponding to stress of 11,100 lb. per sq. in. but did not carry 12,400 lb. per sq. in.

$\frac{12}{R}\sqrt{Rh}$

59 54 59 15 99 20

Table 2: Predicted and Test Loads on Stiffened Sheets in Compression

Length of Specimen, L	6	12	18	12	12	18	15	15	18
Thickness of Sheet, t	0.0190	0.0195	0.0180	0.0320	0.0320	0.0520	0.025	0.032	0.032
Radius of Sheet, R	30	30	30	30	10	30	20	60	Flat
Width of Specimen, W	12	12	12	12	12	12	12	12	12
Effective Width of Sheet, w	5.625	5.625	5.625	3.750	5.625	5.625	5.875	5.750	....
Number of Stiffeners, n	3	3	3	4	3	3	3	3	2 2
Type of Stiffeners, Fig. 4	A-1	A-1	A-1	A-1	A-1	A-1	E-1	C-1	D-1 A-2
Allow. Load on Stiff., P_{stiff}	1550	1300	880	1300	1300	880	810	*2140	†3211 †6753
Allow. Load on Flat Sheet	380	400	345	1080	1080	2860	660	1080	1080
K_1	1.610	1.610	1.610	1.350	2.675	1.610	1.920	1.300	1.00
K_2	1.000	0.790	0.556	0.836	0.869	0.713	0.766	0.627	1.00
Allow. Load on Sheet, P_{sheet}	612	509	311	1220	2510	3285	971	880	1080
$n(P_{stiff})$	4650	3900	2640	5200	3900	2640	2430	6420	9633 13506
$(n-1)(P_{sheet})$	1224	1018	622	3660	5020	6570	1942	1760	4320
Predicted Allowable Load	5874	4918	3262	8860	8920	9210	4372	8180	27459
Maximum Load in Test	5700	5190	3760	8800	7400	5520	4640	8530	31730

*Tested with Strip of Sheet equal to width "W" of Type C-1 Stiffener attached to outstanding flanges of Stiffener.

†Specimen had 4 Stiffeners, one of Type A-2 along each edge and 2 of Type D-1 as intermediate stiffeners, the latter being approximately at the third points of the specimen.

The Curtiss-Wright Amphibian.

Nose Wheels

By Capt. Frank T. Courtney

In our survey of industry opinion on the Department of Commerce light plane program presented elsewhere in this issue, no other proposed feature attracted as much favorable comment as the three-wheeled landing gear with nose wheel. Captain Courtney's experience with nose wheel gears ranges from pre-war types down through the latest Curtiss-Wright amphibian, of which he was the designer.

THE nose wheel as an essential part of a landing gear is not new. Many an old timer, like the original Curtiss pusher, had the main wheels well behind the C.G., with the nose wheel taking its fair share of ground loads. This arrangement however, was abandoned a long time ago. It returns now in an era of far higher loads and landing speeds without benefit of the steady accumulation of experience which has gone into main gear and tail wheel design in the last twenty years.

This article deals primarily with the type of gear in which the main wheels are behind the center of gravity, with the nose wheel a definite requirement for ground operation. Certain gears were tried out some years ago with which the ship did not normally rest on the nose wheel but was fitted with one for one reason or another, usually to permit the main wheels to be put close to the C. G., or just because it looked like a good thing to do. Such nose wheels usually increased those troubles which they were designed to eliminate. Intended as emergency or auxiliary devices only, they were usually of weak or inadequate construction, and when any great load was put on them they generally broke off. The broken parts almost invariably dug into the ground, and

what might have been a gentle nose-over became a highly efficient crack-up. [A number of examples of nose wheel applications of this type are shown on the page opposite. They belong to the period during and immediately following the First World War, and are undoubtedly a hangover from the days when a long nose skid was commonly mounted between the wheels, projecting well forward. Pre-war Farmans and Caudrons exhibited this feature. It persisted into the early 1920's on the British Avros. Going back further into history, the central skid was sometimes the main landing gear member, the wheels serving originally as auxiliaries only.—Ed.] I have seen old F.E. pushers turn over with and without the nose wheel. Without the wheel the front of the nacelle was pushed in with slight damage. But with the broken wheel parts digging into the ground, the landing gear usually suffered partial collapse, and the ship tilted over one side of the triangle of support, smashing the lower wing and shoving the nacelle over sideways. On early Martinsyde Scouts an attempt was made to avoid the triangle effect by putting two small wheels out in front. I have reason to remember this arrangement well. Once when I was a corporal, it caused a general to crack up just after he had bawled me out. His ship, running over rough ground, bucked back and forth from nose wheels to tail-skid until (instead of merely bouncing as might have happened with a normal gear) both front wheels broke off. The broken parts dug in and turned the ship on its back in a beautiful and expensive somersault.

Nose wheels, therefore, should not be considered at all unless they are designed to take the full loads that may be put on them. How severe those loads may be we shall see presently.

Why a nose wheel?

First of all, why use a nose wheel landing gear at all? The strongest reason is to permit the full application of brakes for shortening the landing-run, an obviously valuable feature. (This can be accomplished with the normal gear by putting the main wheels far forward, but this involves a strong tendency toward ground-looping and certain take-off difficulties.) A less obvious advantage, but a very important one, is the clear view ahead obtainable (due to the level position of the ship) when taxiing and during the run after landing. The blindness of the conventional airplane under these conditions—particularly at night or on bad ground—is tolerated only because we have had to get used to it. [See also "Stalled" by Ralph H. Upson, AVIATION, October, 1935.]

The nose wheel was a standard feature of early Curtiss Pushers.

Sometimes structural consideration in the airplane makes the selection of a nose wheel gear necessary. In the recent Curtiss-Wright amphibian, for example, the main wheels could then be placed far enough aft to retract them into the hull instead of into the cabin, where space was at a premium. Again, when a ship on three wheels is at rest on the ground the wings are at a small angle of attack, greatly reducing the risk of blowing over in a strong wind. The alleged advantage of being able to land at any angle doesn't impress me. Almost any ship can do that if it has the shock absorber capacity.

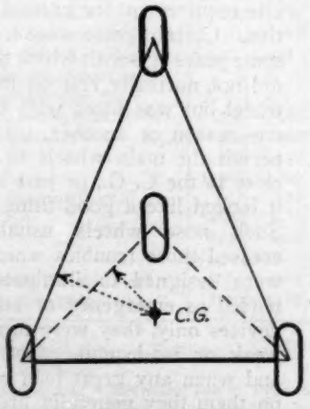


Fig. 1: Importance of placing nose wheel well forward to prevent nose-over.

Design and construction

Certainly a large number of factors affect the nose wheel which scarcely concern the design of a tail wheel: the width of the main gear, the power of the brakes, the height of the thrust line, the force of the thrust, the height of the C.G., the diameter of the wheel for purposes other than loads, the steering factor, and (here I have to reach for the aspirin bottle) retraction.

Consider how the nose wheel gear must be constructed and installed. The first point of importance is the position of the main wheels. If they are too far back, the loads on the nose wheel will be unnecessarily increased and, on the take-off, the nose may remain down too long. A good rough guide is to place the main wheels so that in the most tail-heavy condition they are very slightly behind the C. G. at rest. This gives the pilot the most effective control over the attitude of the ship under most conditions. The nose wheel should then be placed as far forward as possible. In fact, if it is not possible to put the nose wheel well ahead of the C. G. it should not be used at all. If the front wheel is too close-coupled, bad bucking is likely to be experienced when running on the ground. Also, since the nose and main wheels form a triangular support for the ship, the nose wheel will prevent a directly-forward nose-over but, in the case of a sudden swerve, the ship can turn over about one of the forward sides of the triangle. Figure 1 shows the importance of the far forward wheel under such conditions. Again, the farther forward the wheel, the less will be the load on it when the nose is dropped or the brakes applied.

So much for the positions of the wheels. Consider now the construction of the nose wheel gear. The worst condition for load is the application of brakes when the ship is still moving fast with the nose wheel well off the ground. (This condition is admittedly severe, but, unless it can be dealt with, much of the advantage of the nose wheel is lost. My own technique for braking at high speed is to drop or push the nose wheel onto the ground first and then immediately apply brakes, but I doubt if this procedure can be counted on.) This puts a heavy vertical load on the nose wheel, much greater than a tail wheel would be called upon to stand. The higher the C. G., the greater this load will be. This means that relatively long oleo travel must be provided, particularly since a very strong spring would cause the ship to buck back vio-

lently onto the tail. If the nose wheel gear will meet this condition, it will probably meet the "flying into the ground" type of landing so much referred to, provided this does not involve landing on the nose wheel alone. The long oleo travel involves a considerable hanging-down of the nose wheel when the load is off, an undesirable feature, particularly where retraction is involved. And it means a much heavier gear than a tail wheel gear for a corresponding airplane.

Wheel diameter and "shimmy"

Regardless of load considerations, the nose wheel must be of relatively large diameter. At take-off, the propeller thrust forces the nose wheel down. As speed is gathered, a down load on the elevator will relieve that load, but the extension of the oleo will leave the nose wheel still running on the ground. The diameter of the wheel selected will therefore be governed by considerations of ground bumps, particularly on muddy ground.

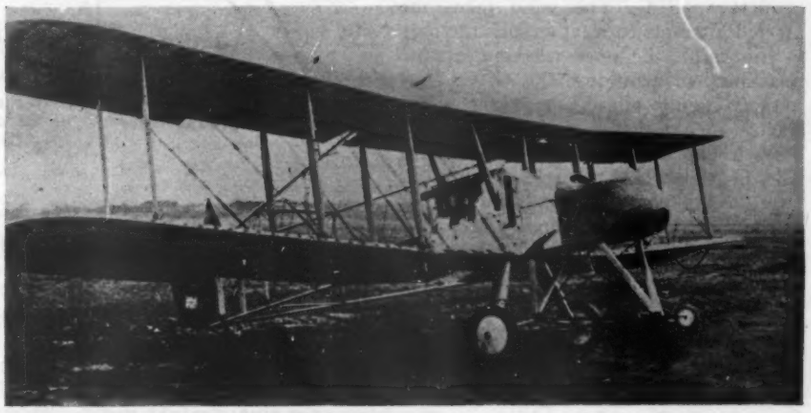
Then there is the question of "shimmy." Without going into the causes of this somewhat obscure and always obnoxious phenomenon, it can be said that it is liable to occur in any normal swiveling system. But it is likely to be much worse for the nose wheel than with a tail wheel because for a given weight of ship, the nose wheel will be larger than a tail wheel, and the forces generated by the shimmy will be greater. If the nose wheel is left freely swiveling, it is liable to shimmy violently; if it is locked it will cause troubles as outlined below; and if a sufficiently effective friction clutch is introduced to oppose shimmy, the wheel may fail to center properly, causing excessive air drag or involving retraction troubles.

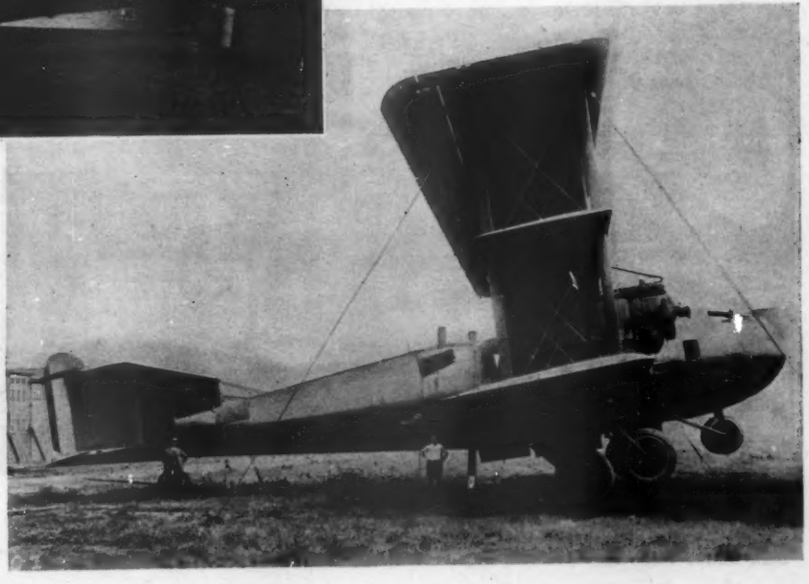
When taxiing, the thrust of the engine, the application of brakes, or the reaction of ground bumps on the main wheels all add to the load on a nose wheel. The same factors tend to relieve loads on a tail wheel. The higher the thrust-line and C. G., of course, the greater this effect will be. The taxiing springs for the nose wheel, therefore, must be stronger and heavier.

Apart from an operating standpoint, structural requirements practically dictate that the nose wheel shall be swiveling and not locked. It is easy to see that the large loads imposed on this wheel may have big lateral components if the wheel is fixed. If it is found necessary to provide a temporary lock (as in the case of some tail wheels), the whole affair will have to be made very strong, and relatively heavy. It must always be remembered that failure of a nose wheel, either in take-off or landing, leads to greater damage than a corresponding tail wheel failure. Herein probably lies one of the greatest objections to the nose wheel.

Braking

As mentioned above, the strongest reason for using a nose wheel is to permit full use of the brakes on landing, but this has problems apart from struc-





Where nose wheels were installed as emergency, or auxiliary devices, they sometimes caused more trouble than they eliminated. Many styles were tried, however, as this group of War and post-War types indicates. Above: The British F.E. 2 night bomber (1915). Left: An early experimental Boulton and Paul (British) bomber tested by the author in 1925. Below: The Barling (U. S. A.) bomber of 1921 had a pair of wheels under the nose.

tural strength. The fact that the three wheels form a triangle is important. It is the possibility of capsizing over one of the forward sides of the triangle under different conditions which is the main problem. Assume the nose wheel locked in landing. It will be seen that, if a sudden application of both brakes is accompanied by any side motion of the ship, the ship's momentum will tend to carry it over around one of the forward sides of the triangle; the ship will not nose directly over, but it will go over forward-and-sideways. Now assume the nose wheel to be swiveling. The ship has landed with a 90-deg. cross-wind from the right, and the brakes are not at first applied. The wind takes the fin and attempts to weathercock the ship to the right, the nose wheel offers no resistance to swinging, the C. G. tries to keep going ahead, the right wheel starts to leave the ground, and the ship tends to capsize around the left-forward side of the wheel-triangle. But suppose the brakes are applied (and, owing to the existence of the nose wheel it is possible to apply them as hard as one wants). Now, if the right wheel tries to leave the ground, the left wheel supplies all the ground-drag, the ship swings back towards the left with still no resistance from the nose wheel, the left-forward side of the triangle runs away from the C. G., and the ship cannot be capsized. At worst it will roll somewhat from side to side, but the chances are against its going completely over.

Ground looping

Neglecting air or wind effects, the basic cause of ground-looping may best be analyzed by an example. Consider two airplanes, one with the main wheels in the conventional position ahead of the C. G. (Fig. 2a) and the other with the main wheels behind the C. G. (Fig. 2b). The ships have landed in direction A and are slowing up. Something —a rut, a stone, difference in wheel friction or whatnot—retards the right wheel and *starts* the ship swinging to right. The momentum—applied at the C. G.—wants to carry the ship in direction Z. This momentum resolves itself into two forces; one, Y, tends to carry the ship on nosewards; the other, X, is transverse to the body of the ship. Clearly, in the case of Fig. 2a, force X will swing the ship still further to the right, until the wheels, trying to skid sideways over the ground, form an excessive brake and the ship noses over. In the case of Fig. 2b, force X tends to pull the ship straight again. Thus the C. G. behind the main wheels encourages, and the C. G. ahead of the wheels discourages, ground-looping tendencies.

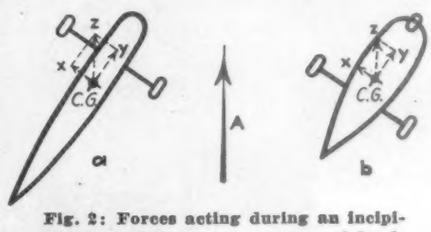


Fig. 2: Forces acting during an incipient ground loop, (a) on normal landing gear, (b) on nose wheel gear.

This is, however, not of much help in a cross-wind landing because in that case the wind will catch the fin and rudder, the nose will swing, producing the capsizing tendency referred to in a preceding paragraph.

If, to meet this situation, the nose wheel is to be locked, then the nose wheel has no great advantage over the tail wheel. If either nose wheel or tail wheel be locked, it has to be dragged sideways over the ground if the ship swings, and thus opposes ground-looping. The nose wheel has the slight advantage that, if the brakes are applied hard, the locked nose wheel will tend to remain pressed hard onto the ground, whereas the locked tail wheel will lose its pressure on the ground and possibly slide sidewise.

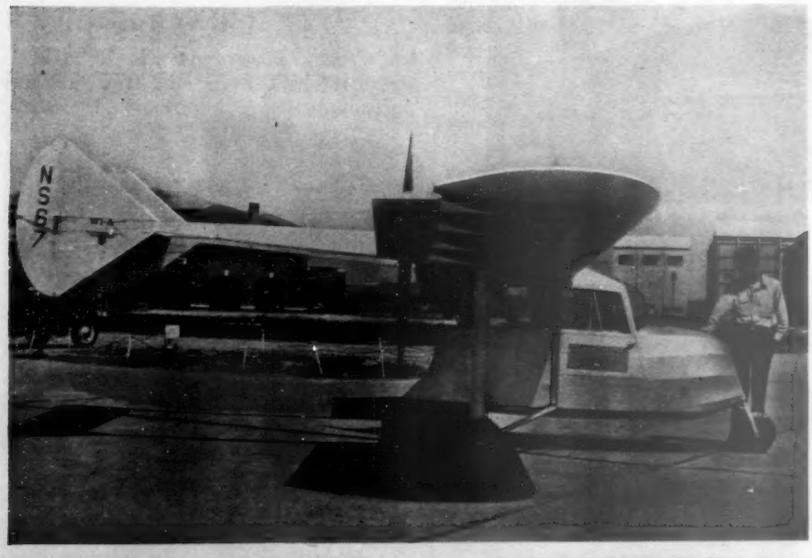
Taking all factors into consideration, I have reluctantly come to the conclusion that the prevention of ground-looping is not much of an argument in favor of the nose wheel. The locked tail wheel does nearly as good a job for much less weight.

Practically the same points apply to the steerable nose wheel as compared with the freely-swiveling or locked wheel. A steerable tail wheel will do about as well, but, being essentially smaller and lighter, it will be easier to control.

Take-off

The nose wheel arrangement is, probably to a measurable extent, detrimental to take-off characteristics. The thrust of the propeller tends to press the nose wheel down on the ground at a time when a tail wheel would be lifted off the ground. The higher the thrust-line, the greater the down load. Thus there is the added friction of the nose wheel during the take-off run, and its added resistance on soft ground. The pilot tends to relieve this load by pulling back on the stick during the run. This, however, merely adds to the effective weight of the ship applied at the main wheels by the down load on the elevators, whereas, with the tail wheel, the elevators are used to reduce all such loads (a factor, incidentally, which is often forgotten in considering the take-off of seaplanes).

These various points in combination might be elaborated upon almost indefinitely, but I think enough has been said to show that the nose wheel gear is not simply a matter of putting a wheel out in front. It is a complicated matter involving many other factors in the design of the ship and in its operation. I personally feel that the advantages of the nose wheel landing gear are such that further study and development should be encouraged. But I certainly do not feel that its advantages are so pronounced and obvious as to lead it to be specified as a panacea for all our landing troubles. The real solution of the problem is, of course, two swiveling nose wheels widely spaced. But weight and other considerations usually rule that out of practical politics.



A recent example where the nose wheel is an essential part of the landing gear, with the airplane C.G. ahead of the main wheels—the Weick experimental light airplane. The same arrangement has been used on both the Hammond and Waterman ships, built to meet the Department of Commerce light plane specification.

Except for the Affair of the Cancelled Contracts, few questions have agitated the aviation industry as violently of late as has the Vidal airplane-in-every-garage idea. To find out just what the industry thought about it,* Aviation *circulated a questionnaire. Here are the results.

This Light Plane Business

AVIATION'S survey on the D. of C. light plane program. Distribution of questionnaires and replies.

Class	Number sent	Replies analyzed	Per Cent return
Airplane Manufacturers	115	52	45.2
Engine Manufacturers	26	11	42.3
Accessory Manufacturers	53	27	51.0
Fixed Base Operators	550	165	30.0
Private Owners and Pilots	232	52	22.4
State Aviation Officials	115	16	13.9
Miscellaneous	28	14	50.0
Total	1,119	337	30.1

IN SPITE of showers of dead cats and brickbats, a great deal more sympathy turns up for the Bureau of Air Commerce program to develop an airplane and an engine for the private market than was popularly supposed to exist. Taking the overall result of AVIATION'S survey of industry opinion there is almost a two to one vote in favor of direct sponsorship by the Bureau. But to accept this figure without qualification would be decidedly misleading because, as shown by the table below, in important industry groups, this ratio does not hold. In fact, aircraft manufacturers show a complete reversal, being practically two to one for the opposition. As might have been predicted, the producing groups look with little favor on any effort of a governmental agency to undertake development work in their particular territory, or to exert undue influence upon established trends or design thought. The consumer groups, on the other hand, (the fixed base operator, the private owner and the private pilot who is a prospective owner) welcome for the most part any move that even aims at putting better or cheaper aircraft within their reach.

The statistics of the distribution and the response to our questionnaire appear in the table above. It may be said safely that a fair cross-section of opinion has been obtained from the industry as a whole. The questionnaire itself was framed as carefully as possible to avoid bias. Only one of the 330-odd replies so far analyzed accuses us of leaning one way or the other. The charge in that case was that the wording of the questions was "unfair to Vidal."

One of the most interesting and important features of the survey is in the comments which accompanied the replies. A great many people took advantage of the invitation to supplement their votes by more extensive comments. In looking over the comments one factor had to be kept definitely in mind and properly discounted. People who were in favor of any particular item on the questionnaire were generally less articulate than those who were opposed to it. Thus, in evaluating the group opinions on any question, it was necessary to qualify the general trend of the comments by giving due consideration to the numerical count of the votes. It is to be regretted that space limitation forbids the quoting of more of the comments in full. Many were amusing. Almost all were instructive. Altogether they would fill many pages of AVIATION.

Among those who favor the Department's program as a whole was a feeling that the aircraft industry lacked the necessary broad gage vision to size up private owner requirements. One fixed base operator said, "Someone should do the job. Why not the Department of Commerce?" Others felt that the industry not only lacked the vision, but the necessary funds to carry out a broad development program and therefore such a project should be sponsored by the government. It was

QUESTION 1: Are you in sympathy with the general idea that the Bureau of Air Commerce should directly sponsor the development of new ships for the private-owner Market? Yes? No?

Class	Yes (per cent)	No (per cent)
Airplane Manufacturers	36.0	64.0
Engine Manufacturers	45.5	54.5
Accessary Manufacturers	55.6	44.4
Fixed Base Operators	69.7	30.3
Private Owners and Pilots	73.1	26.9
State Aviation Officials	62.5	37.5
Miscellaneous	71.4	28.6
Total	62.9	37.1

suggested more than once, however, that the Department confine its efforts to development only and, once the present condition of stagnation is broken, withdraw from the development field and confine its efforts to its original function of regulation.

The consumer's side of the case is summed up by one fixed base operator who says, in part, "It seems to me that the manufacturers do not want to see the market developed. They certainly must know that a market exists for less expensive ships. They certainly must know that they have not sold enough ships at their present prices. . . They resort to many small practices to reduce production costs. They charge too much for extras which should be standard equipment. Every item of replacement material or parts costs far more than it should. The price of a two-cylinder, 40 hp. engine is over $600. This is positively maddening. Now the manufacturers are wailing or sneering over the Bureau's program to make aviation available to a larger number of people. The manufacturers need some stirring up and I hope that the developments now being carried on by the Bureau will force them to act. Aviation needs someone to assume the leadership and develop a quality ship for $1,000 or less." Obviously his acquaintance with manufacturers problems and costs is limited, but it is a point of view not necessarily confined to one individual and one that the industry might well give some attention. A customer revolt, no matter how unreasonable, is always bad news.

QUESTION 2: If the Department is to continue active in that field, do you think it ought to concentrate especially on promoting cheaper airplanes? Or on making them easier to fly? Or both?

Class	Cheaper (per cent)	Easier to fly (per cent)	Both (per cent)
Airplane Manufacturers	13.6	43.2	43.2
Engine Manufacturers	50.0	37.5	12.5
Accessory Manufacturers	10.0	30.0	60.0
Fixed Base Operators	25.2	10.6	64.2
Private Owners and Pilots	30.0	15.0	55.0
State Aviation Officials	....	40.0	60.0
Miscellaneous	27.4	36.3	36.3

QUESTION 3: Do you think that the Bureau's program to date has hurt the sale of existing types of ships? Or helped it? Or had no effect?

Class	Hurt sales (per cent)	Helped sales (per cent)	No effect (per cent)
Airplane Manufacturers	68.6	5.9	25.5
Engine Manufacturers	60.0	....	40.0
Accessory Manufacturers	58.4	12.5	29.1
Fixed Base Operators	60.6	14.4	25.0
Private Owners and Pilots	63.4	9.8	26.8
State Aviation Officials	50.0	7.1	42.9
Miscellaneous	53.8	30.8	15.4

QUESTION 4: If you think that the effects have been harmful, was it due to methods of placing development contracts? Or to the publicity (including the $700 airplane questionnaire) that went out before anything had been done?

Class	Placing contracts (per cent)	Publicity (per cent)	Both (per cent)
Airplane Manufacturers	2.5	57.5	42.4
Engine Manufacturers	....	85.7	14.3
Accessory Manufacturers	6.7	80.0	13.3
Fixed Base Operators	3.6	85.6	10.8
Private Owners and Pilots	....	87.5	12.5
State Aviation Officials	....	70.0	30.0
Miscellaneous	....	92.3	7.7

QUESTION 5: How many actual cases do you know of personally, where airplane sales which would otherwise have been made, fell through because the customer decided to wait for a Department of Commerce ship (or a $700 plane)?

Class	Number of individuals who reported knowing of no actual cases	Number of individuals who reported knowing of actual cases	Total number of sales reported actually known to have been lost
Airplane Manufacturers	32	5	46
Engine Manufacturers	6	2	7
Accessory Manufacturers	21	3	19
Fixed Base Operators	82	24	242
Private Owners and Pilots	16	20	63
State Aviation Officials	5	3	27
Miscellaneous	10	1	2

The comments of the objectors run through the whole gamut of politics, personalities and too much "government in business." More than one manufacturer does not consider the government capable of gaging the requirements of the private market. Frequent charges of "politics" appear. There is a feeling that what business is developed will be thrown to certain favored manufacturers. Others feel that the program is "too socialistic for a free country," that the Department should confine its efforts only to those things that private initiative cannot do.

There was a good deal of talk about the incompetence of the Bureau personnel, but few specific examples were cited. A half a dozen people called for the removal of the Director. One fixed base operator asks, "Is there anyone in the Department who ever bought an airplane with his own money? The Department pays no attention to its inspectors. They spend everyone else's dough and tell everyone what to do, which is bad for aviation."

One suggestion that turned up with surprising frequency was to turn the job of the development of the light plane over to the NACA. One manufacturer said, "I have no objection to government funds being directed towards such full-scale development through the NACA, but not in the form of a directly marketable airplane."

A wrong type?

There is some feeling that the Department was sponsoring a basically wrong type. As one fixed operator put it, "Those desiring a very cheap airplane for sport purposes will find it expensive to buy the cheap plane to learn to fly on. They will soon outgrow it, sell it and buy more expensive planes. Those who desire planes for business or pleasure will want one that cannot possibly be made at the present time for anywhere near $1,000." A number suggested that competition with really adequate prize money would do a great deal more to speed up the developments than the present Department program. A manufacturer offers, "The idea of government subsidizing some particular type and expecting to get direct results is basically wrong. It should either encourage development through prizes for speed, or offer prizes similar to those in Guggenheim competitions. New developments evolved in these extreme types should be modified and put into commercial practice as has been done in the motor car field."

On the question of cheaper machines or machines easier to fly, there is again a marked division between the consumer and producer groups. The manufacturers are predominantly in favor of ease of handling. The fixed base operators and pilots are also interested in ease of flying, but cheapness is much more of a factor with them. As one manufacturer said, however, "Neither can be done until they (the Department) materially loosen up on present engineering requirements." One fixed base operator advances the idea that flying troubles today are more with the pilots than with the airplanes.

QUESTION 6: Which of the following projects, on which the Department is now working, seem to you useful and promising?
(a) Adaptation of automobile engines for planes?
(b) Three-wheel landing gears, with a nose wheel?
(c) Aircraft capable of being driven along a highway?
(d) Tailless airplanes?
(e) Direct-control autogiros?

Class	Votes received for (a)	(b)	(c)	(d)	(e)
Airplane Manufacturers	13	28	8	6	8
Engine Manufacturers	3	8	5	3	4
Accessory Manufacturers	11	17	5	3	7
Fixed Base Operators	92	85	45	16	24
Private Owners and Pilots	22	22	14	2	8
State Aviation Officials	4	10	1	7	4
Miscellaneous	7	12	5	1	6
Total	52	182	83	38	61
Overall Relative Standing	4	1	2	5	3

He says, "I believe learning to use good horse-sense with respect to weather and terrain, is harder than to learn to fly a modern airplane." One state aviation official sizes up the situation by saying, "Cheap planes should never be built. The best are none too good for me. Vidal's talk about a safe $700 plane is child's talk at the present time. He hasn't helped aviation by continually harping on a safe plane. We have safe planes today." The suggestion also recurs that if ease of flying be referred to the NACA, "cheapness will take care of itself by normal competition."

The Publicity Angle

Although there is a majority opinion that the publicity on the light airplane program has definitely hurt the sale of existing aircraft, a number of opinions have been expressed that the publicity actually has helped sales this year "by arousing public interest." As one fixed base operator says, "I don't believe the Department's program has stopped the sale of one single plane. We hear a lot of prospects say they are going to wait for the new plane. To my mind this individual didn't have the funds to spare for any type of plane." To offset, however, are many claims of airplane sales actually lost since the program was inaugurated. We have listed in the tabulation only those cases which were stated as lost without qualification. Beyond that we have a series of estimates such as "About half a dozen," "possibly several hundred," "by hearsay only, many," "innumerable." On the other hand many fixed base operators offer such comments as "absolutely none. The buyers of planes in this territory are smarter than that." "Such talk is 99 per cent bunk, engineered principally by those who grasp at any straw to belittle the Roosevelt Administration," and "None. Believe most prospects using this alibi have no intention of buying present-day equipment in the first place." By and large this question is a very difficult one to evaluate. In a year when airplane sales exceeded last year's sales by substantial margin, it is hard to say how many more planes might have been sold had the Department program not have been started. One guess is probably as good as another.

Of those who believe that the effect of the program had been harmful, by far the majority laid the difficulty to unseasonable publicity rather than to the way in which the contracts were let. One fixed base operator thought that sponsorship was a good thing "but the ballyhoo has had a poor effect." Another thought that the "$700 airplane questionnaire was very poorly worded." On the other hand others thought that "it (the publicity) got people thinking, which may do some good later" and "through stirring up the pot, antagonisms will be created, but new ideas developed."

Design Features

Few of the questions drew down such a rain of scornful epithets as did Question 6. Beyond the serious efforts to reply (which formed the basis of the tabulation) such phrases as "nuts," "bunk," "all dreams," "obsolete," "all foolishness, kid play," were common. Outstanding is the interest in the three-wheel landing gear with nose wheel. (Elsewhere in this issue will be found a discussion of the design of such gears by Capt. Frank Courtney.) Surprisingly enough, road running aircraft crop up as of second place in general interest. But one manufacturer suggested drily that we try driving one on Fifth Avenue. A fixed base operator voted "NO!" on the grounds that "airplanes are about the only means left us to get out of reach of the crazy and drunken drivers on the highways." The general degree of interest shown under subhead (e) of Question 6 should offer some encouragement to the autogiro people.

Altogether 306 specifications for the ideal type of aircraft

QUESTION 7: What specifications would you suggest for an ideal mass production airplane for the private market? Capacity, place. Landing speed, m.p.h. Top speed, m.p.h. Range, miles.

(a) Capacity by Groups

Class	Number of Votes	Seats (per cent) 1	2	3	4	5
Airplane Manufacturers	60	1.7	46.6	18.3	26.7	6.7
Engine Manufacturers	10	0.0	10.0	30.0	50.0	10.0
Accessory Manufacturers	25	0.0	36.0	20.0	40.0	4.0
Fixed Base Operators	187	0.0	43.3	26.7	28.9	1.1
Private Owners and Pilots	57	0.0	45.6	26.3	22.8	5.3
State Aviation Officials	14	0.0	42.8	35.7	21.5	0.0
Miscellaneous	14	0.0	28.6	7.1	57.2	7.1
Totals	367	0.2	42.3	24.5	29.7	3.3

(b) Landing Speed by Groups

Class	Number of Votes	Landing speed (per cent) -/25	26/30	31/35	36/40	41/45	46/50	51/60
Airplane Manufacturers	47	0.0	14.9	17.0	25.5	31.9	10.7	0.0
Engine Manufacturers	7	0.0	14.3	0.0	0.0	28.6	57.1	0.0
Accessory Manufacturers	23	0.0	26.1	4.4	21.7	21.7	26.1	0.0
Fixed Base Operators	157	3.8	14.6	24.9	29.9	12.1	12.8	1.9
Private Owners and Pilots	47	6.4	10.6	31.9	23.5	17.0	10.6	0.0
State Aviation Officials	12	0.0	16.7	16.7	16.6	25.0	25.0	0.0
Miscellaneous	13	0.0	23.1	7.7	15.4	38.4	15.4	0.0
Totals	306	2.9	15.4	21.6	25.8	18.6	14.7	1.0

(c) Top Speed by Groups

Class	Number of Votes	Top speed (per cent) 90 or less	91/100	101/115	116/130	131/150	150/up
Airplane Manufacturers	46	2.2	10.9	4.3	34.8	32.6	15.2
Engine Manufacturers	7	0.0	0.0	0.0	14.3	57.1	28.6
Accessory Manufacturers	23	0.0	13.0	30.4	26.1	8.7	21.8
Fixed Base Operators	159	4.4	11.9	20.1	31.4	25.9	6.3
Private Owners and Pilots	45	4.5	17.8	15.5	37.8	15.5	8.9
State Aviation Officials	12	0.0	8.3	16.7	58.4	8.3	8.3
Miscellaneous	13	0.0	15.4	15.4	23.1	7.7	38.4
Totals	305	3.3	12.5	17.1	32.7	23.3	11.1

(d) Range by Groups

Class	Number of Votes	Range in Miles (per cent) 200/299	300/399	400/499	500/599	600/up
Airplane Manufacturers	47	6.4	27.7	19.1	31.9	14.9
Engine Manufacturers	7	0.0	28.6	28.6	28.6	14.2
Accessory Manufacturers	23	13.1	17.4	26.1	21.7	21.7
Fixed Base Operators	152	9.2	23.0	26.9	35.0	5.9
Private Owners and Pilots	45	6.7	15.5	26.7	31.1	20.0
State Aviation Officials	12	0.0	25.0	25.0	16.7	33.3
Miscellaneous	12	0.0	16.7	25.0	58.3	0.0
Totals	298	7.7	22.1	25.6	32.9	11.7

QUESTION 8: Do you think that the Department is on the right track in trying to convert automobile engines to air plane use? Yes? No?

Class	Yes (per cent)	No (per cent)
Airplane Manufacturers	19.1	80.9
Engine Manufacturers	30.0	70.0
Accessories Manufacturers	38.4	61.6
Fixed Base Operators	51.5	48.5
Private Owners and Pilots	50.0	50.0
State Aviation Officers	20.0	80.0
Miscellaneous	50.0	50.0

QUESTION 9: Assuming that engines could be made exceedingly cheap, and highly reliable, could we afford to go back to power plants having practically the same weight and the same power as the old OX-5? Yes? No?

Class	Yes (per cent)	No (per cent)
Airplane Manufacturers	25.5	74.5
Engine Manufacturers	12.5	87.5
Accessory Manufacturers	36.0	64.0
Fixed Base Operators	35.5	64.5
Private Owners and Pilots	37.2	62.8
State Aviation Officials	23.6	76.4
Miscellaneous	38.5	61.5

for the private market were analyzed and tabulated. These yielded a general trend of opinion of the various groups toward questions of capacity, landing speed, top speed and range.

Looking at the capacity table, it is apparent that the trend of opinion was toward the two or three-place ship in practically all groups. Airplane manufacturers followed this general trend but the engine and accessory people generally wanted larger airplanes, centering about the four-place type. The fixed base operators' opinion reflects not only their own desires as pilots and operators but also something of the requirements of their potential customers as distributors. The private owner and private pilot vote follows the fixed base trend very definitely. Obviously few people as yet are thinking of the airplane in terms of a family carry-all.

The vote on landing speed covers a range from the wishful thinking of the pilots and private owners, through the more practical knowledge of the fixed base people, to the engineering analyses of the manufacturer. Thus the center of gravity of opinion of the private owners and pilots falls on a landing speed of about 35 m.p.h., the fixed base operators concentrate at about 40 m.p.h., and the manufacturers closer to 45.

For top speed, all groups come into a little closer agreement. In spite of continual talk of speed and more speed, it is apparent that everyone concerned would be content with an airplane which showed a top in the neighborhood of 125 m.p.h. Quite a few fixed base operators and pilots would be willing to drop well below this limit and would get along with ships flying at around 100 m.p.h. This trend is, of course, tied in with the desire to use engines of reasonable horsepower operating at reasonable cost. Again, as might be expected, the engine manufacturers who voted tended toward much higher speeds and therefore to much higher power requirements.

Range requirements are also reasonably modest. The 500-mile figure occurs most frequently, possibly because it is a good round number, but more likely because it is well within practical limits and gives the prospective user a chance to really go places with his airplane.

Summing up, the general consensus of opinion seems to be for a two or three-place airplane, landing at 40 m.p.h., with a top speed of about 115 and a range of 500 miles. One fixed base operator said, "The average business man wants a plane solely for pleasure. Give him a conventional looking airplane, closed, and not too noisy, slow but not too slow, one that will land on a golf course."

That engine question

The part of the Department program concerning the adaptation of automobile engines to aircraft has been subject to the most violent discussion. Again, as with the general vote on the whole program, the two groups emerge, producers and consumers. The three manufacturing groups stand almost three to one against any attempt to modify automobile engines for aircraft, but the owners and fixed base operators as a group are pretty much on the fence with an almost 50-50 vote. One thought the idea was "just plain screwy," another favored it "if this work will get some large manufacturer into developing an engine designed for airplanes," and another voted "yes" because "We are going to have to continue operating at lower rates and this certainly can't be done with present power plants."

The question covering engine weight was perhaps a bit too academic. Many who OKed automobile conversions in Question 8 were against doing so at the cost of much extra weight. The general consensus was definitely against running up weight excessively although there were a number of people who felt that improvements in general aerodynamic efficiencies might go a long way toward offsetting the extra poundage. One fixed base operator considered it all right "for short range private ownership or fixed base training where reliability and economy are more necessary than weight carrying efficiency." Owners and operators are not as weight-conscious as the airplane manufacturer who stated that "engine weight including starter, generator, fuel pump, propeller hub, partial cowling and exhaust system, must not be over 2 lb. to the horsepower, and perhaps less."

It became obvious from the trend of replies to Question 10 that the horsepower grouping was badly selected, particularly in the 100 and 200 hp. class. This range should have been broken down at least into two groups, one of which ran from 100 to 125 and the other from 125 to 200. Summing up the tables and the general trend of comment, however, it is apparent that the majority opinion favors an engine of about 100 to 110 hp., although the fixed base operator group, again with an eye on economy, is willing to drop under that figure, centering probably about 90 hp. A good many, for sentimental reasons, perhaps, held up "the good old OX-5" as a mark to aim at for the conversions.

QUESTION 10: In your opinion what horsepower range will be most useful for the ideal private owner airplane? 25-45; 45-60; 60-75; 75-100; 100-200; 200 hp. and up

Class	Number of Votes	Horsepower (per cent) 25/45	45/60	60/75	75/100	100/200	200/up
Airplane Manufacturers	55	1.8	5.4	9.1	34.6	38.2	10.9
Engine Manufacturers	11	0.0	0.0	0.0	36.3	54.6	9.1
Accessory Manufacturers	29	0.0	3.5	17.2	37.9	34.5	6.9
Fixed Base Operators	212	1.4	2.4	6.6	48.6	35.8	5.2
Private Owners and Pilots	45	0.0	0.0	6.7	42.1	44.5	6.7
State Aviation Officers	17	0.0	0.0	5.9	70.5	17.7	5.9
Miscellaneous	14	0.0	7.1	0.0	35.8	50.0	7.1
Totals	383	1.1	2.6	7.1	45.3	37.4	6.5

Editorials

AVIATION

Watch Those Wires!

NO ONE who has any occasion to use the airlines or to fly cross-country can be out of sympathy with a movement now afoot to eliminate all overhead electrical wiring from the vicinity of landing fields. We are behind it 100 per cent. All too often we have felt decidedly uncomfortable dragging into certain fields over a net work of "hot" wires. It is bad enough in the daylight and clear weather. But at night, especially in fog, those wires actually seem to be reaching out to trip us up, until the wheels touch down on the runways.

Here is a type of hazard to which aircraft should not be exposed, and one that can be eliminated if sufficient pressure is brought to bear. There can be no better place to apply funds now being made available for airport improvement through WPA and other agencies than in getting power lines away from the edges of flying fields, either by rerouting them, or by putting them underground. Work has already been started in some localities. Chicago, notoriously dangerous because of high transmission lines near its municipal airport, has taken steps to remove them. Other cities should follow suit,—and at once, before serious trouble occurs. If the owners of power lines are not willing to cooperate voluntarily, means must be found to compel them to do so. Since public safety is involved, the proper city, state or federal authority could and should be invoked to eliminate all such hazards.

Pilots are People

CONGRATULATIONS to a pair of our popular contemporaries, *Saturday Evening Post* and *Esquire*, for their recent sound and sober articles on air transport. We are making progress indeed when editors of non-aeronautical publications are willing to put into the hands of their readers such sensible and straightforward accounts of how airlines really operate, and what sort of people fly the ships.

If any widespread misconception needed de-bunking badly, it was that hangover from the late lamented 1920's that pictured all pilots as dashing heroes, with "clear, gray eyes, blond curly hair, bronzed cheeks" and a flair for recklessness,—getting the mail through in spite of hell and high water, barely missing the tree-tops in the process, milling about in blinding storms with engines stuttering over the last few drops of gasoline.

All of which reads well in the story books, but doesn't help much in building up traffic for the air lines.

Now the halos are coming off, and it is a good thing. Simply telling people, however, that airline pilots are carefully selected, highly trained and constantly supervised may be impressive, but is not always convincing enough to induce them to patronize the airways personally. But, there is definite psychological value in getting across to the public that pilots, besides being highly trained professional men, are just ordinary people like themselves, that they have homes and families to get back to when the days' work is done. The picture of the air line pilot returning to his home in the suburbs, picking up a snack from the family icebox, and going out with his wife for a quiet evening of bridge at a tenth of a cent a point with his bank clerk neighbor, has in it elements that engender confidence. Such things go a long way toward breaking down a feeling that still persists that flying, or riding in an airliner is an unusual and risky procedure.

Safety Measure

A LOT of people went off half-cocked over the order that went out from the Bureau of Air Commerce early in November restricting the use of the airline radio facilities under conditions of limited visibility. If there was any doubt about the temporary character of the original order, it was quickly cleared up at the conference held in Washington immediately after its publication and in the modifications that resulted. A great deal of work still remains to be done before a completely satisfactory solution is found to the ever increasing problem of the control of air traffic for maximum safety, but as a temporary measure, we think that the Department order with its modification of Nov. 15 is fair and reasonable. The government airway facilities are still open to anyone who has two-way radio equipment and can demonstrate his ability to use it. He can't go off and fly for the fun of it near federal airways or terminal airports in bad weather, but if he must go places, all the Department asks is that he fly according to a prearranged flight plan, be subject to dispatcher control at take-off and at destination, and that he keep all concerned informed as to his whereabouts at all times. Surely this is not an unreasonable restriction, and it may be the means of avoiding a major tragedy until some better solution to the problem turns up.

Flying Equipment

The general arrangement of the ship, showing the relative positions of the various control elements. Insert shows trailing edge rotor tabs.

Giro Without Wings

Mechanical details of the Kellett K.D.-1 direct control giro.

The KD-1 in flight.

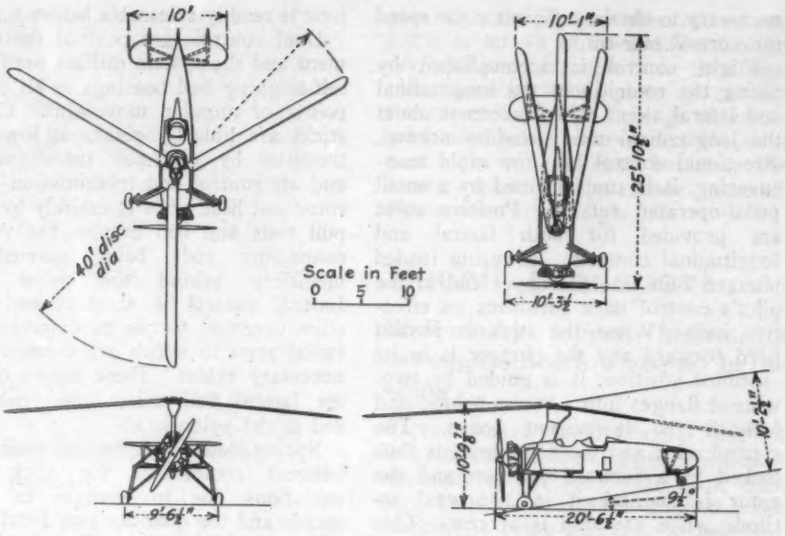
THE IMPROVEMENTS in flying qualities and ground handling of direct control autogiros have been discussed frequently but the methods used to solve the incidental mechanical problems are much less familiar. Through the cooperation of R. H. Prewitt, chief engineer of the Kellett Corporation, we are able to present the mechanical details of the K.D.-1 machine, which have resulted from several years of development and flight testing. The first of these devices is the rotor blade damper.

This damper has been devised to limit the oscillations of the individual rotor blades about their vertical hinges. It consists essentially of an internal spring-loaded, oil damped, self-centering device. The plunger is actuated by a roller and double-node cam. The entire mechanism is housed within the fork end of the blade spar. (See Sketch A.)

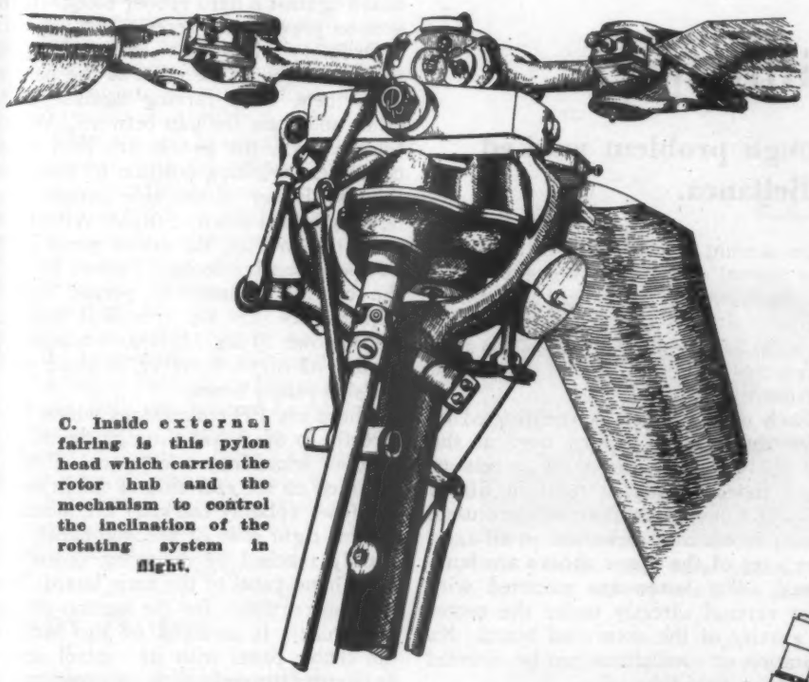
On the upper end of the rotor hub (see Sketch B), which is a heat-treated alloy steel axle, are the droop and coning stops and the horizontal articulating pins. On the lower end is the spiral bevel ring gear for the rotor starter. Radial and thrust ball bearings are used in mounting the axle. The lower radial bearing is mounted in the lower section of the two-piece magnesium alloy cast

hub case. Rotor starter pinion and bearings are also carried in the lower section of the case. To the top of the case is bolted the hub cap, a heat-treated machine steel forging, integral with which is the trunnion for lateral tilting of the hub. From this trunnion the flying loads are transmitted to the main aircraft structure through a heat-treated steel yoke. The hub cap also carries the principal rotor flying loads and only the starting torque and radial loads from the lower axle bearing are transmitted to the magnesium case.

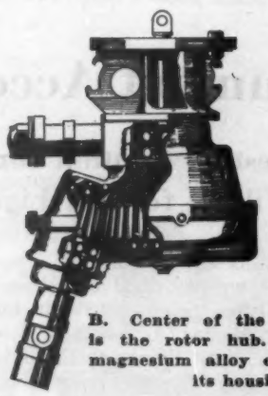
Longitudinal control of the rotor is accomplished by trunnion mounting of the yoke in the forked upper end of the pylon (C). The pylon is attached to the upper fuselage truss by bolting to a welded tubular tripod. At this point all torsion and bending are transmitted from the pylon strut to the fuselage structure. Axial loads and such side loads as a result from the upper point of fixity are transmitted to the lower fuselage truss through a forged steel strap fitting at the lower end of the pylon. The entire pylon structure together with the lower hub case including bell cranks, control rods and cables, are enclosed in a streamlined dural fairing. (See general arrangement, p. 30.)



Four views of the KD-1. Little storage space is required for the machine with rotor blades in folded position.

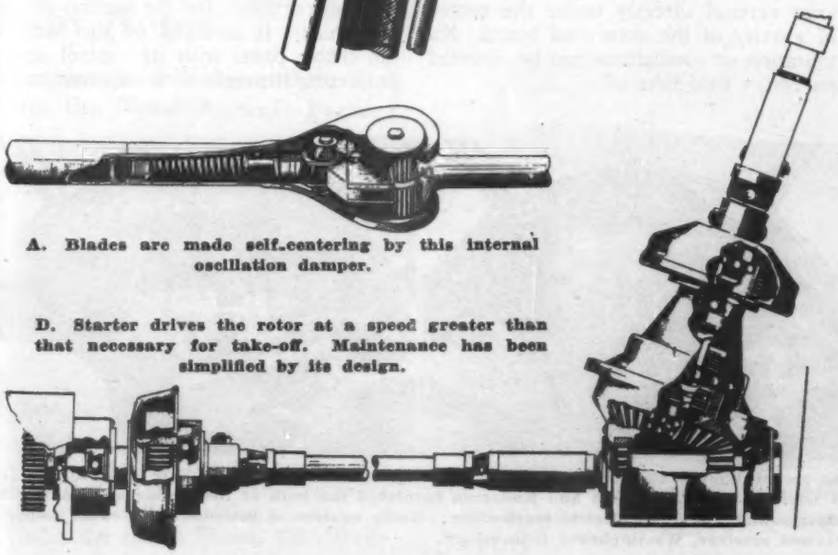


C. Inside external fairing is this pylon head which carries the rotor hub and the mechanism to control the inclination of the rotating system in flight.



B. Center of the blade system is the rotor hub. A two-piece magnesium alloy case serves as its housing.

A. Blades are made self-centering by this internal oscillation damper.



D. Starter drives the rotor at a speed greater than that necessary for take-off. Maintenance has been simplified by its design.

The rotor starting system (D) has been improved mechanically and the most of the maintenance difficulty with earlier forms have been eliminated. A constant torque clutch and the lower gear case are supported by fittings bolted to the lower end of the pylon strut. The clutch is designed to preclude the possibility of overloads being transmitted to any part of the starting mechanism or to the structure itself. As an additional precaution, a grooved nickel steel clevis pin connects the upper end of the upper drive shaft to the universal joint, serving as a safety connection of predetermined breaking strength. Clutch and brake are operated from conveniently mounted ratchet levers in the pilot's cockpit.

To realize any improvements in take-off characteristics that may be derived from over-speeding of the rotor, the mechanism is designed to transmit a load considerably in excess of that

necessary to obtain sufficient rotor speed for normal take-off.

Flight control is accomplished by tilting the rotor about the longitudinal and lateral axis. The movement about the longitudinal axis provides normal, directional control but, for rapid maneuvering, it is supplemented by a small pedal-operated rudder. Positive stops are provided for both lateral and longitudinal controls. A spring loaded plunger built into the upper end of the pilot's control stick furnishes an effective lock. When the stick is pushed hard forward and the plunger is in its extended position, it is guided by two-winged flanges into a recess behind and beneath the instrument board. The control stick and the rotor head is thus locked in a forward position and the rotor is maintained in a neutral attitude while the ship is at rest. This affords protection against high winds and permits take-off in a strong wind without first "tailing-in." The stick lock is readily releasable before take-off.

Dual controls are part of the equipment and the system utilizes needle and self-aligning ball bearings at all critical points of angular movement. Control sticks are linked together at lower extremities by push-pull tubes for fore and aft control and transmission to the rotor and head yoke is entirely by push-pull rods and bell cranks, the vertical connecting rods being carried immediately behind the pylon strut. Lateral control is accomplished by a stick operated torque tube having two radial arms to which are connected the necessary cables. These cables operate the lateral bell crank and push-pull rod at the pylon head.

Spring-loaded longitudinal and lateral bungees compensate for stick force variations due to changes in flying speeds and the quantity and distribution of load. Both bungees are loaded by the same spring and are connected to the rotor head by means of cables.

Instrument Accessibility

An interesting solution for a tough problem worked out by Viking for Dr. Light's Bellanca.

SEVERAL months ago (AVIATION, September 1935) we described the Wasp-powered Bellanca Skyrocket built for the use of Dr. Richard U. Light of New Haven, Conn. Now, thanks to Franklin T. Kurt of the Viking Flying Boat Company, we have a very complete description of the instrument board installation of that ship, with particular reference to accessibility, not only on the ground, but in flight. The arrangement was conceived by Dr. Light, was carried out by Earl Neill and Franklin Kurt of the Viking company.

The board contains seventeen instruments, a number of lighting switches, rheostats, vacuum regulator, thermocouple, and radio receiver and transmitter controls and meters. With this large amount of equipment in the space of a normal sized board, accessibility to the back would have been extremely difficult. It was attained, however, by dividing the board into three panels each of which is hinged about its lower edge independent of the others.

Each of the panels is constructed of $\frac{1}{8}$ in. dural sheet flanged over at the edges. To allow the three panels to move independently, a total of fifteen pairs of Lord shock absorbers are used, giving freedom of movement in all axes. The axes of the upper shocks are horizontal. The lower are mounted with axes vertical directly under the center of gravity of the assembled board. No vibration or oscillations can be detected on rough field take-offs.

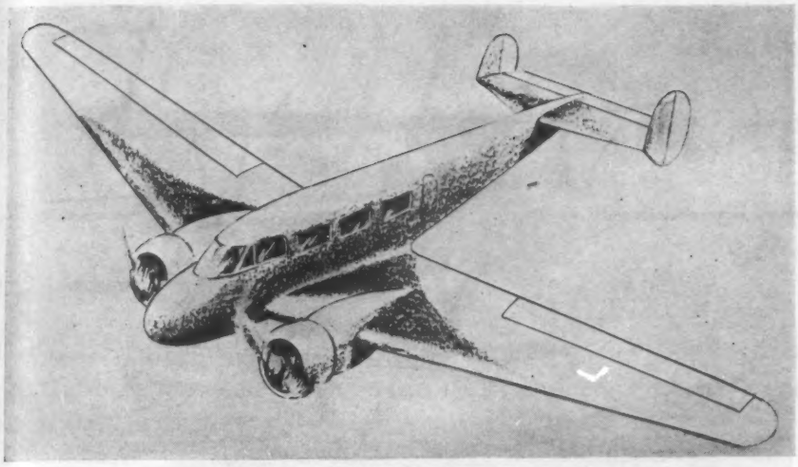
The lower shock units are mounted on brackets riveted to the lower flange of each panel. They connect with mating units on brackets welded to athwartship steel tubes. The latter are supported at their ends and by two brackets from the firewall. They are normally prevented from rotating in their bearings by spring loaded stops. By releasing the stops the tubes may be rotated by means of handles projecting below the board thus relieving the shocks of undue distortion as the panels are folded foreward. The handles and stops serve to center the panels when folding them back into place.

The upper edges of the three boards are fastened by large nickel plated brass thumb screws which pierce the board and mate with a nut riveted to a small flanged dural bar. This bar is attached through shock units to brackets which extend down from the deck above the board under the windshield. When screwed up tight, the thumb screws press the dural bars against the back of the board against a hard rubber block which acts to prevent the screws backing off.

Ordinary felt window channel riveted to the flanges at the edge of the panels keep them from jarring against each other and seals the gap between. When folded down, the panels are held in a convenient working position by rawhide thongs. Either of the side panels may be fully folded down in flight. With help from the co-pilot, the center panel may be opened up far enough (before hitting the control column) to permit minor adjustments. On the ground it may be folded down 90 deg. It is quite accessible around its edges, however, in place with the side panels down.

There are 109 connections which lead directly to the board through flexible U tubes or wires from a sub-panel of dural mounted on the rear side of the firewall. All fuses (plainly marked) are mounted on the right side of the sub-panel, are readily reached by swinging down the right hand panel of the main board. The vacuum regulator for the suction driven instruments is mounted on the back of the center panel with its control screw projecting through. It is adjacent to the

Left to right: General view of board showing yellow line to visually isolate sections according to function. Note grouping of the flexible connections and accessibility to fuses while in flight. Pioneer and Kollsman furnished the bulk of the engine and navigating instruments except the gyro and horizon by Sperry and the G. E. electric tachometer. Radio equipment included Lear radio compass and receiver, Westinghouse transmitter.



Preview of the 1936 Beech transport.

suction gage and may be regulated in flight. This arrangement makes only one vacuum lead to the board necessary. Heavy rubber welding gas tube has been found the most suitable for the purpose.

The board is finished in dull black. An interesting feature is the enclosing of certain groups of instruments with a simple pattern of yellow lines ($\frac{1}{8}$ in. wide) to act as a guide for the pilot's eye. Thus the navigational instruments are isolated from the others by an enclosing yellow line. A line also separates the instruments from the light switches, vacuum regulator, thermocouple selector, rheostats, ammeters, etc., which lie in a line along the bottom of the board. A short vertical line on each side isolates visually the radio receiver on the left and the transmitter on the right.

Any sort of lighting may be used satisfactorily with this type of board, but it is particularly adapted to a system mounted completely behind the board. Bulbs may be changed easily in flight. The back-board mounting also affords illumination for any necessary adjustment to the instruments.

Navy Notes

A seaplane conversion and the first from the Naval Aircraft Factory

IN AVIATION for September, 1935, we described the landplane version of the latest Curtiss-Wright two-place scout observation type for the Navy, the SOC-1. Now comes a picture of the same machine mounted on a single float for catapulting from battle ships and cruisers for fleet cooperation work. Altogether 135 of this type (convertible, land or sea) are being built for the Navy at the Buffalo plant. Outstanding feature is the combination of slots and flaps on the upper wing. Power plant is a Pratt & Whitney Wasp, in a full NACA cowl with trailing edge flaps for controlled cooling.

Under the recent Vinson bill, 10 per cent of aircraft produced for the Navy must be built in Philadelphia's Naval Aircraft Factory. First unit so produced is the XN3N-1, two-seater for general training and observation use. Little is known of its specifications or performance. It appears to be a two-place open cockpit biplane of conventional structure, with fuselage of welded steel tube, fabric covered for the most part. The fin is all metal but other surfaces appear to be fabric covered. Power plant is a Wright J-5.

Beech Transport

Preliminary reports indicate a two-engine Beech transport in the offing

REPORTS have been filtering out of Wichita that a two-engined Beechcraft transport is due to appear some time early in 1936. It is a fair guess that the machine is being prepared to meet the specifications of the Department of Commerce for a transport for feeder line service.

Provision is being made for two pilots

Official Photograph, U. S. Navy

The Curtiss SOC-1 as a seaplane for fleet cooperation work. It is stressed for catapulting. The upper wing carries both slots and flaps.

Official Photograph, U. S. Navy

First product of the Naval Aircraft Factory under Vinson Bill requirements. The Navy's XN3N-1.

forward and for a passenger cabin with seats for six. Alternate arrangements for three or four people or for executive use will probably be offered. Luggage and toilet compartments will be in the rear.

With two 275 hp. engines, the cruising speed is calculated at about 185 m.p.h. The ceiling with single engine is estimated at 8,500 ft., on both engines, approximately 20,000 ft.

Waco on Floats

Model CPF Waco passes D. of C. tests as seaplane on Edo floats

RECENTLY Waco's chief test pilot, John Livingston, brought a new Model F East for testing on Edo floats. The job was finished at the College Point plant and after test flying off North Beach Airport, the Department of Commerce granted an ATC for the CPF as a twin-float seaplane. It was licensed at a gross weight of 2,880 lb. The top speed averaged 142.6 m.p.h. at 2,400 r.p.m., cruising, 127 m.p.h. at 1,900 r.p.m. With full load, take-off averaged nineteen seconds.

The ship is a standard open cockpit biplane, powered with a Wright R-760-E engine of 250 hp. The floats are the new Model Edo 45-2880. They follow usual construction and general design practice, but they have been cleaned up a bit, and the vee bottom forward of the main step has been made a little deeper. Standard water rudder equipment is fitted. Maneuverability on the water is reported to be excellent.

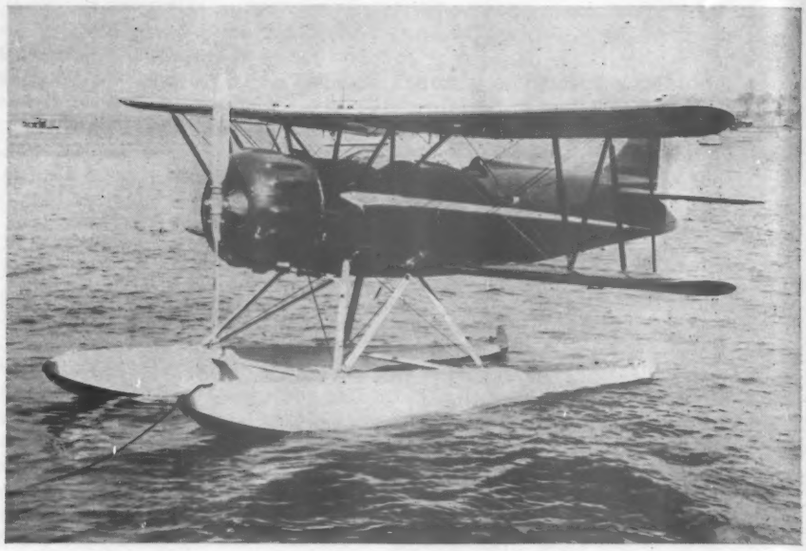
Foreign Builders

Final King's Cup notes and a few oddities

THE Percival Gull is a popular standard type for touring England. One of these machines, specially fitted with a 200 hp. Gypsy VI won the Siddeley Trophy in the King's Cup race. It is normally a low-wing, three-seat cabin monoplane with a cruising speed of somewhat over 150 m.p.h. It has a fixed landing gear, well streamlined.

One of the more unusual ships in the finals of the King's Cup race was the TK2, a machine designed and built by the students of the DeHavilland Technical school. It was a low-wing cabin monoplane with a wing design very similar to that of the Comet which won the MacRobertson race last year. It is fitted with a Gypsy Major engine.

A modification of the standard cabin type Percival Gull has been turned out for delivery to one of the Indian Princes of Jodhpur. Instead of the usual closed cabin arrangement, two tandem open cockpits are provided. Power plant is a standard Gypsy VI.



A sea-going Waco, the CPF powered with a Wright R-760-E engine of 250 hp. Top speed is better than 142 m.p.h.

Although the British DH86 four-engine transport has been described previously, an accompanying illustration shows the latest type (4-200 hp. Gypsy VI engines) as used by Imperial Airways on the London-Budapest and London-Brindisi services. Of particular note is the long tapered nose, characteristic of all late models of this machine.

A curious looking amphibian has appeared recently in France, the Armella-Fenemaud Mistral. It is a high wing single hulled type with two Gypsy Major engines mounted under the trailing edge as pushers. Most unusual feature is in the mounting of the landing gear. The wheels appear to be set into a pair of short-wing stubs which act as stabilizers on the water. For ground landings, the stub and wheel combination is lowered so that the wheels come well below the hull. For water use the whole arrangement is raised to act as a pair of sea-vanes. Handley Page slots are used along the trailing edge only in conjunction with a relatively wide flap. Altogether the machine is rather awkward looking. Nothing is known so far of its characteristics or performances.

Interest in Germany seems to continue toward low-powered gliders. Among most recent examples is the B.G.15-1 a light single-placed type which in general outline suggests the Curtiss-Wright Jr. of 1932. Power plant is a two cylinder horizontal opposed air cooled engine. Wings are not tapered, are markedly swept back.

Most interesting of the German power glider experiments is the Haessler-Villinger human powered machine. It has the appearance of a normal sailplane except for a streamlined mast which extends out of the forward deck and carries a propeller at its top. The propeller is driven through a suitable belt drive by foot pedals operated by the pilot and, once the machine is in the air (apparently after being towed off or launched by shock chord) the pilot can obtain a considerable amount of thrust at the propeller. A number of flights from level ground have been made. The longest reported so far covered some 700 ft. Not very spectacular, of course, but as far as is known, the first flights which have been made by human power. The practical value of the experiment is, however, open to some question.

British transport, the De-Havilland DH-86, used by Imperial Airways.

The Maintenance Notebook

Cold Weather Maintenance

C. M. Belinn, superintendent of maintenance for National Airways, Inc., discusses some of the problems of winter operations under sub-Arctic conditions

OPERATING an airline in the triangular area, Boston-Bangor-Montreal, particularly in the dead of winter, presents a number of very highly specialized maintenance and operating problems. Experience gained in operating a fleet of Stinson Model Ts since 1933 has yielded a number of lessons on cold weather maintenance that may serve as a guide to others facing similar circumstances.

The main problem breaks down into three general subdivisions. The first concerns the design of suitable accessories and fixtures for preheating engines for starting purposes. The second has to do with the maintaining of normal operating temperatures in flight, both around the engine and in the cabin. The third deals with the airport maintenance problem, particularly with regard to landings on icy areas and the upkeep of runways.

Starting cold engines

Number one problem, of course, is the starting of engines after overnight layup in temperatures as low as 50 deg. F. below zero. For an operation where frequency of schedule is low, it is necessary, for economy, that a minimum number of employees be kept at each station, and it is therefore desirable to make preheating equipment as simple and as easily operated as possible. It is highly undesirable to drain and to preheat oil outside of the engine. This usually requires labor that is not readily available, and also subjects the oil to possible contamination from dirt. It also introduces a "human element" problem, for personnel occasionally fail to put back plugs, caps or to replace safety wires. Altogether it seems best to heat up the oil in the engine. At the same time all the engine parts warm up to or near operating temperature. It has therefore been found advisable to design a hood similar to a regular engine cover, fitting tightly all around, so arranged that incoming heat is directed where it is needed most. For Lycoming engines the induction system and the entire rear section of the engine are the critical spots. By using a Type 605A plumber's firepot connected to a sheet metal telescoping stove attached to the engine cover, as illustrated, a Lycoming engine can be brought up to summer operating temperature in from 20 to 30 minutes.

Keeping engines warm

Once an engine has been started in extremely cold weather, however, there is no assurance that it will stay up at proper operating temperature. If it is very cold, the chances are that it won't. Under such conditions no amount of running on the ground will bring up full throttle power output. First move is to add to the usual lagging of oil-lines and tanks. Ordinary "5 and 10 cent store" ironing board pads have been found convenient and economical for this purpose. This material is cut to proper shape, wrapped around the tank or oil-line, then sealed on the outside with water glass and powdered asbestos. In addition it is usually necessary to reduce the amount of cooling on the cylinders themselves. This can best be done by wrapping a part of the cylinder in a sheet metal jacket as shown in one of the accompanying pictures. The width of the jacket may be varied to suit the temperature conditions encountered and it may also have a few holes punched in it to permit a limited circulation of air. For temperatures between 20 deg. F. and 50 deg. below zero, the jacket 2 in. wide with a 1½ in. opening at the back was found to be ideal. Two ⅝ in. holes were punched in front.

Keeping cylinder temperatures up by means of the jacket is important not only to maintain full engine power during flight (a decided loss of power has been noticed where cylinder temperatures have been allowed to get excessively low) but also to make full power immediately available in cases where throttles must be opened suddenly at the end of an approach glide to correct for undershooting or for wind drift. Some trouble was encountered from both these sources before the jackets were applied, but after jacketing, planes could be flown without trouble at temperatures as low as 55 deg. below zero.

So far, engines with sheet metal fin jackets have been operated for a total of over 4,800 hours. It was expected that overhaul would disclose scuffed pistons, scored cylinders, bent rods, or other trouble. Surprisingly enough, however, it was found that none of these conditions existed, and that the actual wear on cylinders was lower than that usually encountered under summer conditions. The only point where excessive wear occurred was in one of the oil pump drive gears. The cost of replacing this gear at frequent intervals, however, is probably much less than the sum total of the cost of operations under the former operating plan and is, therefore,

Engine covers, stoves and plumber's pots set up for preheating the engines of a Lycoming powered Stinson at an outlying station on National Airways.

considered well worth accepting. One surprising thing noticed in overhaul was the lack of sludge in the crankcase. In several engines the usual heavy ends of oil were totally lacking and the engine could be reassembled for a new running period without the usual sludge cleaning process. Taken on the whole, cold weather operating under controlled conditions, appears easier on engines than normal operations at higher outside temperatures.

Keeping warm inside

Providing heat for pilot and passengers and visibility for the pilot through frosted windows are other problems. With ordinary cabin heating units, temperatures inside sometimes went as low as 25 below zero, and it was necessary to make use of a new unit, a sort of superheater, to take all possible exhaust heat from one engine and transfer it into the cabin. A 5-ft. stainless steel pipe was used for the principal heating element. All exterior hot air baffles and insulating shells were made removable so that the pipe itself may be easily inspected, and no welds were made on the heater tube proper. Hot air from the stove is led into the cabin through 2 in. diameter flexible radiator pipes along each wall under the seats. A branch pipe carries a stream of heat into the cockpit, discharging over the pilot's feet.

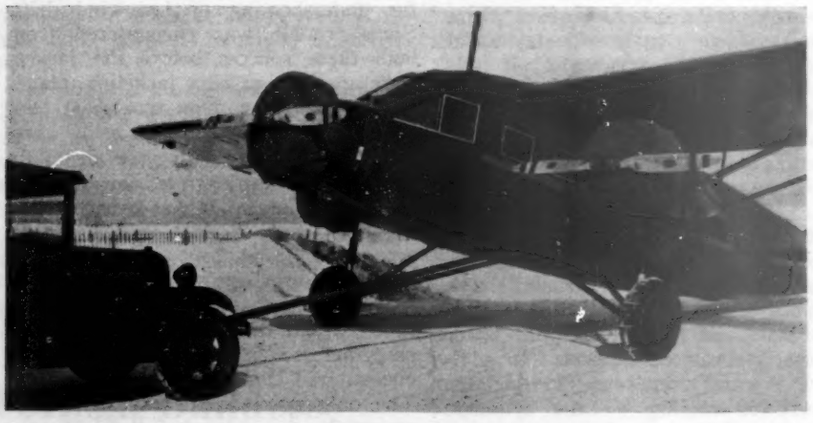
At 30 deg. below zero or under, windows frost very badly. Best results so far have been obtained by using a double window in the cockpit with a sealed vacuum space between two panes of glass. An auxiliary outlet from the heating system permits the directing of hot air onto the windshield to help clear off the ice.

The lubrication of controls and other auxiliaries under low temperature is very important. Only by applying the best grades of lubricant with great frequency can they be kept reasonably free. Under extreme conditions, Varsol (a light cleaning compound) may be used to replace lubricating oils. Straight graphite may also be substituted for ordinary cup grease.

Runways and skid chains

In winter operations it has been impossible to use ski-type landing gears because some landings must be made on airports which are regularly kept free of snow. This makes it necessary to use wheel gear on the ships, and also to maintain cleared runways on all fields. Careful study has been made of prevailing winds at airports, for it is an expensive operation to maintain snow runways on eight airports over a 400-mile airline. Every plowing must be done with an eye toward future snowfalls because the snow which is plowed from a runway banks up along the sides and in the course of the winter the banks tend to become higher and the cleared runway narrower. The original plowing must therefore be done on such a scale that any succession of snowfalls may be handled without making the landing strip too narrow for safe operations.

During thaws the snow which melts from the banks along the runways tends to flow into the center and upon refreezing converts the landing strip into a sheet of ice. It is necessary to find some means to prevent airplanes from skidding upon landing to maintain complete ground control. It has been found very practical to equip the planes with anti-skid chains. The chains selected are simply a high grade automotive type with cross-links kept in good repair and unusually sharp. Chains must be so attached that there will be always one cross-link in contact with the ice at any time. Care must be taken in braking not to lock the wheels, as that is certain to produce a skid. After long experience, pilots report that the chains are invaluable, and quite frequently make the difference between the carrying out of a scheduled flight or complete cancellation.



Non-skid tire chains assist winter operations on icy runways. Note also the bar which may be used either to tow or to push planes when on the ground.

Sheet metal jacket covering part of the cooling fins of a Lycoming cylinder.

Emergency heating equipment carried in each of National Airways' planes during the winter. The case at the left contains three plumber's pots. The crate on the right contains engine covers and stove piping.

Operator's Corner

An exchange of ideas on the problems of the commercial aviation industry

QUESTION 11: Do you find much interest in college student flying in your community? What proportion of the students in school or college may be expected to be prospects for flight instruction? Have you made any attempt to sell the local educational institutions or their student bodies on the benefits of collective or individual flight instruction? If so, what were the results?

Vacation time best

IN 1927 we made arrangements with the Pennsylvania Military College of Chester to teach seaplane flying to their students. The college is close to this station and the students are of well-to-do class. Results were satisfactory until 1929, after this, the parents of most students were not able to pay the extra fee and at present only two students are active in flying. When times get better we expect at least 5 per cent of the students to enroll with our school.

The students' time at this college is well taken up and we had to limit the lessons to one or two short flights per week. If the weather on these days proved unsuitable, students got dissatisfied and this together with long summer vacation which these students spent away from college made progress slow and uncertain. Our plan was to refund 25 per cent of the tuition fee to the college, to make it interesting to them and help pay for any extra effort they made to secure flight students for us.

Our opinion is that a college student's time is so taken up with his studies during his term that it would be much better if flying instruction was given during vacation time. — FRANK MILLS, *Senior Flying Instructor, Essington School of Aviation, Essington, Pa.*

★

QUESTION 12: What do you do to get the public out to your airport? What methods such as air meets, radio broadcasts, etc., have you employed for this purpose?

River sports attract

SINCE we operate solely from the Mississippi river we have found that it is not necessary to use extraordinary means to attract interest to our locations. However, as there is a certain amount of recreational interest already in boats, locks, and dams, etc., which are located adjacent to us, we find that their presence helps to attract attention to our type of operation. Seaplane flying itself is very interesting to watch even for the general public and many people, we find, are so fascinated by it that they spend hour after hour, evening after evening, for weeks at a time, just watching our plane operate.—GEORGE C. DUVALL, *Mississippi Airways, Davenport, Iowa.*

Acrobatic stunts attract

THE air show seems to be the best method of getting people out to the airport. It will undoubtedly get more people than any other method, provided a little publicity is put out ahead of time regarding it. However, the public soon gets tired of seeing the same planes and the same pilots doing the same things, and so it is usually necessary to vary the program considerably to hold the public's interest. The Airshow does not need to be a large, stupendous affair, but a few acrobatic stunts to occur hourly or at a scheduled time during the afternoon will always increase the attendance at any airport.

The city council of Seattle, shortly after Boeing Field had been built, changed the name of the principal highway to the Field from the downtown business district to "Airport Way." The name of "Airport Way" on all road signs undoubtedly does a good bit of advertising for the field. However, we do not have much trouble getting crowds out to Boeing Field so we have never considered it a problem.—A. ELLIOTT MERRILL, *President, Washington Aircraft & Transport Corporation, Boeing Field, Seattle, Wash.*

Prizes from the sky

WE find about the best method to get the public out to the Airfield is to advertise and put on free attractions in the air and also to drop both Merchandise and cash prizes on parachutes at stated intervals. Mrs. Canfield and I have had considerable publicity relative to our coyote hunting activity by plane. We put on a demonstration at the Airport of how we shoot coyotes from a plane, shooting from the air in our little "Coyote Special" in which, to date, we have bagged 931 coyotes. This seems to go over big with the public.—E. M. CANFIELD, *Canfield Flying Service Inc., Williston, N. D.*

Seaplane facilities limited

WE advertise in local papers, several times per year, place cards in show windows, have made some radio broadcasts but nothing really systematic due to the small amount of business we can handle at this school. Seaplane bases are not very suitable for air meets due to limited ground to take the proper care of visiting planes but should be a great boost to land fields. A properly located airport should derive a large income from non-aeronautical attractions such as dance halls, roller skating, and lunch stands.—FRANK MILLS, *Senior Flying Instructor, Essington School of Aviation.*

Radio is best

WE have used every method, including machine guns, of getting the public out to our airport. Of all the ideas, we have found radio the best. (see page 16, November, 1935 issue of AVIATION). A recent successful attempt was to stage a flower show at the airport. A large number of florists exhibited their wares and the attendance was excellent. —C. C. MOSELEY, *President, Aircraft Industries, Grand Central Airport, Glendale, Calif.*

Question 13

(Answers will be published in January)

WHAT is the price asked for your shortest flight? Have you ever offered flights at a lower price and if so what was the result? Have you had other ships barnstorming at your port charging less and if so what was the result of their operations? Have barnstormers using Fords or similar equipment, and charging only 35, 50, and 75 cents helped or retarded your business? (Submitted by George C. Duvall, Mississippi Airways, Davenport, Ia.)

Question 14

(Answers will be published in February)

WHAT do you think of the present regulations for medical examinations for flight students? Do they discourage students from getting started because of the expenditure of time or money involved. Would there be any great risk in amending them to defer the examination until the student had several hours of dual? Should the number of medical examiners be increased or should the examination privilege be extended to other physicians? Should the Air Commerce Bureau permit operators to charge for the flight demonstration time up to one hour that is now allowed only if given free?

News of the Month

★ ***Transport*** **. . . Pan American starts transpacific mail with perfect first crossing . . . Second Clipper reaches California . . . New Zealand approves extension from Honolulu to Auckland . . . Latin American services stepped up to 150 m.p.h. . . . Aerovias Centrales has difficulties with Mexican nationalism . . . American airlines describes new Douglases . . . Bureau of Air Commerce takes steps to prevent blind collisions . . . United plane crashes on test near Cheyenne . . . Bureau reports on earlier United crash and Western Air Express accident.**

★ ***Army and Navy*** **. . . Stevens and Anderson make stratostat record from Black Hills camp . . . Eastern GHQ to attend Miami Air Maneuvers . . . Giant Boeing bomber crashes at Wright Field. Board finds no structural failure.**

★ ***Record Flights*** **. . . Russian pilot beats FAI airplane altitude record . . . Kingsford-Smith lost in Malayan typhoon . . . Ellsworth missing in the Antarctic.**

★ ***Foreign*** **. . . Dutch report on line to Batavia indicates perfect schedule maintenance.**

★ ***Financial*** **. . . General Motors sells TWA control . . . United reports third quarter profit . . . American Airlines reports nine months loss.**

★ ***Miscellaneous*** **. . . Cleveland sponsors issue plans for 1936 Races ten months in advance . . . Hendersons expect extensive exhibits for Aircraft show in February . . . WPA speeds airport projects toward goal of 750 total.**

Pacific Overture

China Clipper makes first flight with mail, as sister ship arrives in California. Other Pan American lines step up

THERE WERE elaborate ceremonies under way at the Alameda, Cal., seaplane terminal on the afternoon of Nov. 22. Postmaster Farley read a message of congratulation from the President and made a speech of his own, as did Juan Trippe and the Governor of California. Even the Governor of Hawaii and President Quezon of the Philippines were heard from by radio. A crowd of 20,000 lined the shores. A band played. The departure of the first transpacific airmail was not to be lightly passed over.

Finally, to the great relief of Captain Musick and his crew of eight, the last of the 2 tons of mail creaked up in an ancient stage coach, and went on board the Clipper. Soon the great Martin-built boat was taxiing smoothly toward a takeoff that lifted it above the unfinished towers of the Golden Gate bridge just before four o'clock.

Twenty-one hours and three minutes later Musick nosed it down to a smooth landing on Pearl Harbor, Hawaii. Once more—bands, speeches and excited crowds.

The next afternoon the China Clipper had reached Midway with a dozen Pan American employees taken aboard at Hawaii bound for Midway and Wake to relieve some of the members of the base crews who had been on duty since last May.

Three days later its crew stepped ashore for final ceremonials in Manila itself.

Forty-eight hours after the China Clipper had taken off for the Philippines, a sister ship, the Philippine Clipper, arrived in San Francisco Bay. Still another was expected early in December.

Company officials announced when the China Clipper turned homeward after three days in Manila, that the second flight with mail scheduled for Dec. 6 would likewise go no farther than the Philippine capital. After that service will be extended through to the Portugese island of Macao off the coast of China near Canton. Passengers will not be carried until February.

Three other developments marked the Pan American month. Oct. 29 came word that the government of New Zealand had approved a Pan American service from Hawaii to Auckland to start possibly late next summer.

November 15, came trouble in the form of an order from the Mexican government that "on that very date" Aerovias Centrales, Pan American subsidiary running from Los Angeles and El Paso to Mexico City, must substitute Mexican for American pilot personnel. Pending a compromise, the airline shut down.

November 1, it put its entire Latin American network on a 150 m.p.h. schedule basis. Douglases, Electras, S42's acquired during the past two seasons made the change possible.

Bigger Transports

American releases details of Douglas DC-3s.

AS THE first of the Douglas DC-3 transports (also called DST-s) neared the flight test stage at the Santa Monica factory last month, American Airlines which has ordered ten of them, released more complete descriptions of the new transports than have been previously available.

Externally they will closely resemble the present DC-2 model. The wing span will be 95 ft., length 65 ft., height 17 ft. 6 in., compared with DC-2 measurements of 85 ft., 62 ft., and 16 ft. 4 in., for the corresponding dimensions. Wing arrangement, structure type, general contours will remain the same, save in one instance. The DC-3 fuselage will be 30 in. wider giving, incidentally, a somewhat better streamline shape.

Mounting two engines of almost 1,000 hp. each, speed performance will closely approximate that of the smaller ship—a top of 215 m.p.h. at 7,000 ft., a cruising speed of 190 m.p.h. at 12,000 ft. at 70 per cent power. Fully loaded the new ships will weigh 24,000 lb. against the 18,000 of the DC-2. Range—and this is important—will be 1,100 miles with the ship carrying 24 passengers as a day transport, 1,400 miles when made up as a 16-passenger sleeper.

President Smith of American called attention to the fact that the new Doug-

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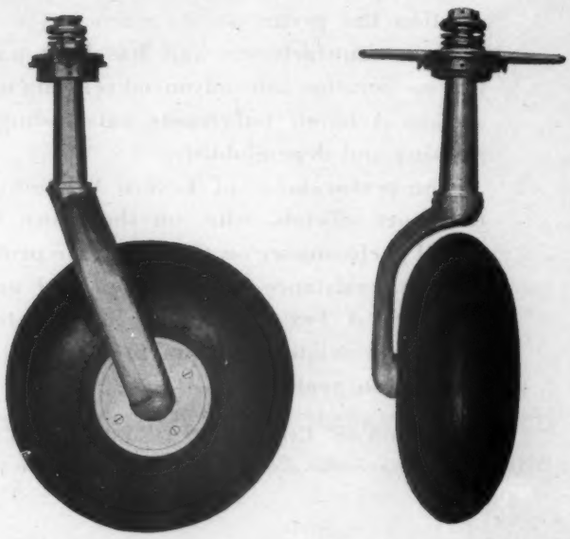

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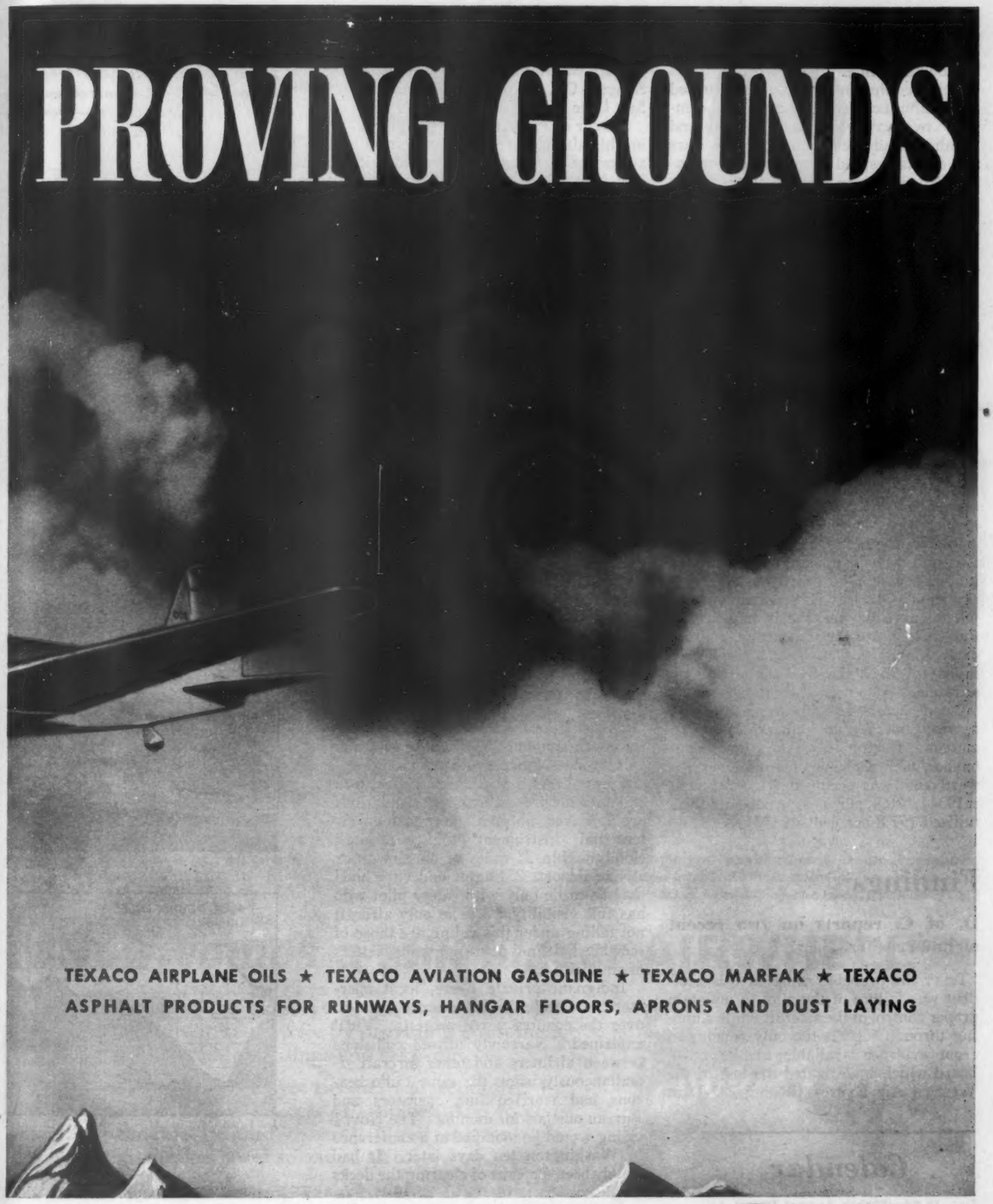

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lases, which will cost more than $1,700,000 with spares, complete a $4,500,000 equipment expenditure started two years ago by his airline.

Other equipment programs announced last month included the purchase of complete two-way radio by Chicago and Southern and the mounting of de-icers and constant speed propellers on the entire Northwestern fleet of Electras on the Chicago-Seattle run.

KLM Report

Schedule keeping on the long Amsterdam-Batavia run.

BECAUSE the American aeronautical industry likes to think of the aggressive Royal Dutch Airlines (K.L.M.), which have long used American engines and for the last half year flown their principal schedules in Douglas transports, as the most nearly Americanized airline in Europe, the report on this summer's operations of its Amsterdam-Batavia service holds special interest.

June 1, the new Douglas schedules of five and a half days replaced former nine-day winter and eight-day summer services. On July 1 departures were put on a two-a-week basis in place of the former weekly frequency. From early August to Oct. 1 not a single trip failed to cover the 8,000 mile trip on schedule.

Load factors fell due to the doubled service but by a remarkably small amount. During July, August and September, 67.7 per cent of offered service westbound was occupied (82.8 per cent in1934), 70.3 per cent eastbound was utilized (77.8 per cent in 1934).

Findings

D. of C. reports on two recent airline crashes.

"THAT the probable cause of this accident was failure of the pilot to maintain proper control of the aircraft while climbing through fog" is the only conclusion from evidence available to the crash board which investigated the loss of the Western Air Express Boeing 247-D at Burbank on Sept. 1, 1935. Only crew and mail were aboard at the time. The ship was being ferried from Burbank (where weather conditions were bad) to Saugus, Cal., to pick up passengers for Salt Lake City.

"Error on the part of the pilot in judging his altitude or his distance from the airport or both" caused the accident to a U.A.L. 247-D transport 10 miles northwest of Cheyenne (Wyo.) in the early morning of Oct. 7, 1935, according to official crash board findings. No evidence of mechanical failure could be found. The ship brushed the top of a small knoll in normal flying attitude—wheels up, engines at cruising speed—crashed against a hillside 1,100 ft. away. There are some grounds to suspect that the pilot either misread his altimeter, or that the setting was at fault, as an additional 1,000 ft. of altitude at the point of the accident would have put the ship in the proper position for a normal power glide to the airport for a landing. The pilot was known to have been flying on instruments at the time of the crash. It is possible also that he misunderstood the co-pilots position report, and started losing altitude faster than his actual position warranted.

New Beam Rulings

Bureau of Air Commerce takes steps to prevent blind collisions.

ON Nov. 1 the Bureau of Air Commerce issued an announcement whose gist was as follows—Notice to all pilots and operators: 1. As a precautionary measure and until the present tentative regulations are approved, no pilot shall make an intentional instrument flight through clouds within 25 miles of an airway or airline airport. 2. Flights under the hood may be made only with safety pilot who has full visibility. 3. The only aircraft not falling under this ruling are those of scheduled airlines operating under letters of authority.

Indignant private flyers, local operators, and radio manufacturers from all over the country wired protests. Vidal explained. Narrowly missed collisions between airliners and other aircraft simultaneously using the same radio beacons had worried line operators and Bureau officials for months. The Nov. 1 ruling would be modified at a conference in Washington ten days later. It had simply been a means of clearing the decks for discussion.

On Nov. 15 another "temporary" order was forthcoming which retained the above but added as exceptions aircraft with two-way radio capable of a 25 mile range, and manned by personnel who have demonstrated their ability to use it.

However, when pilots of such craft do take advantage of such exceptions they must communicate if possible with all Department of Commerce stations along the route, must submit to the Bureau representation and at least one airline a flight plan at their point of departure to be teletyped ahead to destination. Such plan not to be deviated from, except in emergencies.

Reports on the Washington traffic control conference have not yet been published. A preliminary report is expected

Calendar

Dec. 12-14—Eighth Annual Miami All-American Air Maneuvers, Miami, Fla.

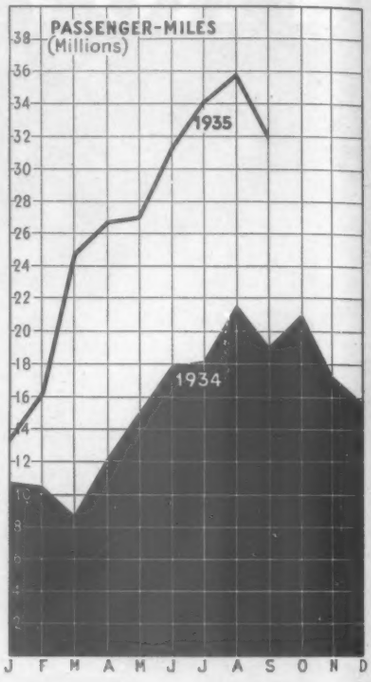
May 15, June 1, 1936—International Aero Exhibition, Stockholm, Sweden.

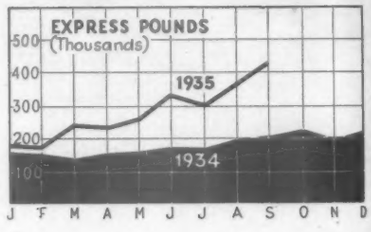
Sept. 3-6, 1936—National Air Races, Cleveland, Ohio.

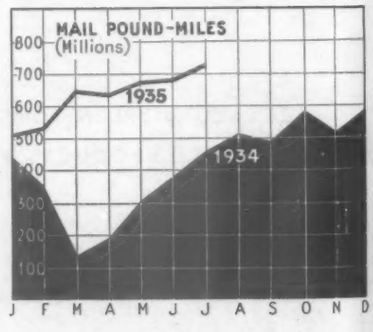
Oct. 25, 1936—Paris-Saigon Air Race.

Traffic

Latest available statistics from the Bureau of Air Commerce and the Post Office Department—Domestic airlines only







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early in December. Final findings must await for the results of intensive studies of the sub-committees of operators, pilots and private owners appointed Nov. 12.

Locked Controls

Army Board finds no structural or engine failure in 299 crash.

NO EVIDENCE of failure of structure or of control surfaces, nor failure nor malfunctioning of engines or propellers was found by a Wright Field crash board investigating the loss of the Boeing 299 bomber at Dayton on Oct. 30. All testimony of observers and survivors led to the conclusion that "the direct cause of the crash was the locked condition of the rudder and elevator surface controls (primarily the latter) which made it impossible to control the airplane." Why they were not unlocked will never be known, for Major P. P. Hill, the pilot, died in the wreckage. Possibly the lock had never been disengaged,—possibly the unlocking handle had been only partly depressed,—possibly the handle had been fully depressed, and for some reason the locking pins were not fully disengaged. One guess is probably as good as another.

If underlying causes were obscure, the results were tragically plain. In the language of the official report "299 . . . on duly authorized test flight, took-off, immediately assumed an abnormally steep climbing attitude, continued in this attitude until it stalled at approximately 300 ft. altitude, and then crashed, power on, on the airdrome, and immediately caught fire."

Major Hill probably did not survive the impact. Leslie R. Tower, longtime Boeing test pilot, received injuries and burns from which he died three weeks later. Heroic work on the part of field personnel saved the lives of the others of the crew, co-pilot Lt. Donald L. Putt, flight test observer John B. Cutting, and mechanic Mark H. Koogler.

The loss of 299 narrowed the field of competitors for new Army bombers (for which bids were opened on Aug. 22) down to the Douglas and Martin entries.

Ten Months Notice

National Air Race program for 1936 released. Prize money boosted to $60,000. 1935 Earhart Trophy troubles.

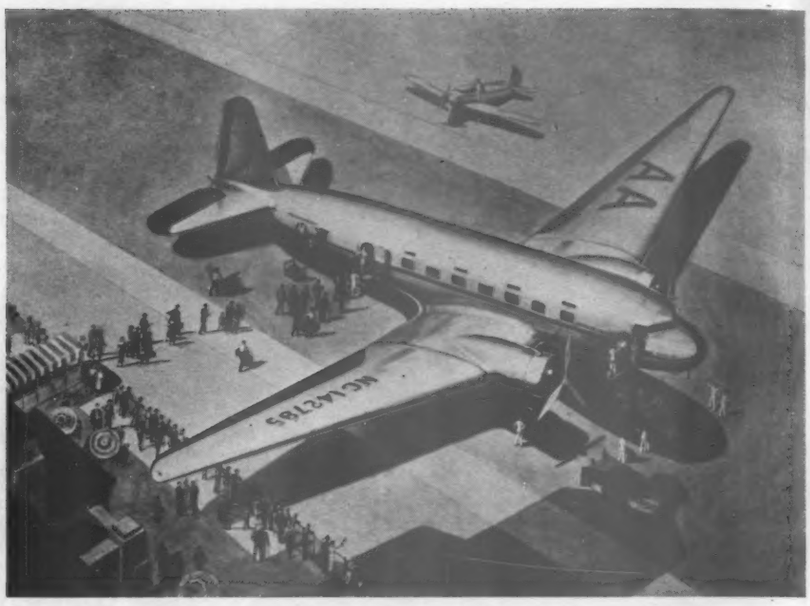
TOTAL prize money for the 1936 National Air Races at Cleveland will be 20 per cent higher than it was this year. Special bonuses will be offered for new National Air Race records in the Thompson, Bendix, Greve, and 375 cu.in. races. The 200 cu.in. class contest has been replaced with a race for planes equipped with engines of 266 cu.in. or under. The handicap race for women will carry a top speed limit of 175 m.p.h. in place of this year's 150 m.p.h. and a new qualifying speed of 100 m.p.h.—such were the high spots of the release last month from the Cleveland sponsors about next year's National Air Races to be held Sept. 3, 4, 5 and 6.

Most significant of all was the fact that the release of such information at this time marked a new departure. In the past it rarely appeared before late spring or early summer. More prize money, bonuses for meet records, ten months' notice of classes and qualifications should do much toward insuring better race performances.

Prize money posted for the principal events — Thompson, $20,000; Bendix, $12,500; Greve (550 cu.in.), $13,000; 375 cu.in., $9,000; 266 cu.in., $2,400; Women's A. T. C., $1,500; Men's A. T. C., $1,000; Parachute Competition, $600.

The N.A.A. has announced a final settlement of a situation arising from an error in handicapping of this year's Amelia Earhart Trophy Race.

Immediately after the finish of the race Mrs. Melba Beard was named the winner of the race, with Mrs. Edith Bernson in second place by a fraction of a m.p.h. Soon after, an error in the computation of Mrs. Beard's starting time was discovered and the position of the two leaders reversed. Now after full review the N.A.A. has ruled Mrs. Beard should be credited with winning the race and be awarded the trophy but should receive only second money, first money to go to Mrs. Bernson.



1,400 MILE SLEEPER

otherwise the Douglas DC-3, otherwise the Douglas DST. An artist's drawing of the new 24-passenger day transport—16-passenger sleeper nearing test flight at Santa Monica. American Airlines has ordered ten.

Los Angeles Show

Details released on West Coast aircraft display.

MORE data are now available on the National Pacific Aircraft and Boat Show beyond the bare announcement of a month ago. The date has been definitely set, Feb. 1-9. The location will be the huge Pan Pacific Auditorium, modernistic 110,000 sq.ft. display building in the center of Los Angeles residential district. The same building was recently the site of Los Angeles Auto Show and National Housing Show. It is the second largest exposition building in the United States.

The Henderson brothers, Cliff and Phil, who manage the National Air Races, will also manage the coming show for the California Air Industries Association, which consists of leading southern California manufacturers, distributors and operators and is headed by Harry H. Wetzel, vice-president and general manager of the Douglas Aircraft Company. The Association's show committee consists of Palmer Nicholls of Pacific Airmotive, Carl B. Squier of Lockheed, and Walter P. Balderston of the Pacific Scientific Company.

Active support has been promised by the Los Angeles Chamber of Commerce, Junior Chamber of Commerce, and the local Chapter of the N.A.A. The exposition has been sanctioned by the Aeronautical Chamber of Commerce.

An extensive list of exhibitors is expected. The Henderson's announce that early reactions promise the largest show since pre-depression days.

Air Temperature Indicator Model 602

Volt-Ammeters Model 506

Blind Landing Indicator Model 635

Tachometer Indicator Model 543

Radio Compass Indicator Model 602

Ammeters Model 606

Oil Temperature Indicator Model 606

Carburetor Air Temperature Indicator Model 606

Cylinder Temperature Indicator Model 602

WPA Airport Projects for which Treasury Warrants had been issued—Nov. 22, 1935

For the preceding two months we have carried tables of projects that have secured first Washington approval. Please note that this table lists projects two stages further on—projects that have received first approval from relief authorities, then approval by the regional or district supervisors of the Bureau of Air Commerce, and finally had treasury warrants issued in their favor. Information has been received that the President and Director Hopkins have approved a blanket program of 750 airport relief projects.

Alabama (total)	**$106,818**
Columbiana	7,561
Dadeville	3,068
Mobile	68,203
Tuscaloosa	27,986
Arizona (total)	**$23,118**
Douglas	13,152
Phoenix	9,966
Arkansas (total)	**$49,280**
Fort Smith	4,179
Paragould	14,720
Pulaski County	17,890
Searcy	12,491
California (total)	**$1,141,625**
Bakersfield, Delano, Mojave, Taft	132,480
Calexico	12,586
Chester	22,963
Long Beach	113,359
Los Angeles	52,992
Madera	22,963
Mariposa	86,554
Marysville	29,808
Merced	33,120
Modesto	15,456
Montague, Dunsmuir	26,717
Oakland	326,011
Oxnard	14,793
Palo Alto	13,469
Sonora	26,386
Stockton	161,956
Susanville	13,761
Visalia	22,963
Willows	10,819
Woodland	2,469
Colorado (total)	**$61,992**
Alamosa	8,905
Cortez	5,088
Pueblo	47,999
Connecticut (total)	**$343,709**
Groton	134,855
Meriden	133,534
New Haven	75,320
Florida (total)	**$280,047**
Clermont	7,458
Fort Lauderdale	48,038
Fort Ogden	33,913
Naples	78,101
St. Petersburg	93,215
Tampa	19,322
Georgia (total)	**$29,177**
Milledgeville	7,528
Quitman	21,649
Illinois (total)	**$474,905**
Bloomington	99,392
Chicago	2,578
Moline	372,935
Iowa (total)	**$71,848**
Council Bluffs	39,356
Des Moines	16,912
Ottumwa	15,580
Massachusetts (total)	**$300**
Athol	300
Michigan (total)	**$825,910**
Alma	4,982
Big Rapids	11,759
Cheboygan	15,836
Detroit	318,095
Escanaba	26,661
Gladstone	4,150
Gladwin	5,106
Kalamazoo	54,493
Laurium	4,694
Menominee County	3,505
Newberry	11,575
Niles	31,996
Onaway	4,121
Petoskey	19,161
Pontiac	64,546
Rogers City	22,760
Saginaw	181,000
St. Ignace	21,481
Sault Ste. Marie	17,459
White Cloud	2,530
Minnesota (total)	**$88,189**
Bemidji	11,008
Detroit Lakes	4,195
Duluth	7,548
Grand Marais	9,056
Hibbing	23,676
Ortonville	7,553
Virginia	25,153
Mississippi (total)	**$677,423**
Amory	29,206
Bay Springs	28,851
Biloxi	47,313
Columbia	30,546
Columbus	43,730
Corinth	44,962
Grenada	30,437
Gulfport	22,592
Hattiesburg	2,675
Jackson	43,950
Laurel	7,510
Louisville	25,427
Lumberton	10,145
Magee	28,243
McComb	25,917
Oxford	67,167
Picayune	2,165
Poplarville	26,375
Tupelo	62,314
Union	20,276
Vicksburg	48,015
Yazoo City	29,607
New Jersey (total)	**$175,006**
Egg Harbor City	15,984
Morristown	159,022
New Mexico (total)	**$15,010**
Carlsbad	3,796
Santa Fe	11,214
New York (total)	**$3,540,294**
Albany	320,000
Buffalo	1,805,160
Canastota	40,000
Newburgh	120,000
Norwich	80,000
Ogdensburg	120,000
Rochester	360,000
Schenectady	60,000
Tompkins County	60,000
Utica	160,000
White Plains	703,134
Nevada (total)	**$1,883**
McDermitt	1,883
North Dakota (total)	**$40,908**
Fargo	40,908
Ohio (total)	**$217,206**
Akron	193,966
Portsmouth	23,240
Oregon (total)	**$148,000**
Portland	148,000
Pennsylvania (total)	**$33,058**
Lancaster	33,058
South Carolina (total)	**$254,542**
Aiken	11,453
Anderson	18,661
Cheraw	12,521
Columbia	119,586
Georgetown	24,527
Hartsville	15,016
Laurens	32,880
Orangeburg	14,150
St. James, Goose Creek	5,748
South Dakota (total)	**$56,875**
Brookings	2,040
Hot Springs	3,195
Huron	17,810
Rapid City	24,270
Redfield	9,564
Tennessee (total)	**$713,724**
Jackson	2,548
Kingsport	665,899
Nashville	45,277
Virginia (total)	**$393,324**
Bedford	19,435
Blacksburg	4,757
Blackstone	15,568
Bluefield	13,440
Bristol	27,170
Colonial Beach	23,402
Danville	22,550
Farmville	19,635
Gordonsville	15,568
Hopewell	35,044
Isle of Wight County	23,403
Lynchburg	56,096
Parksley	15,578
Petersburg	13,513
Roanoke	24,068
Staunton	11,681
Surry	13,440
Waverly	15,568
Williamsburg	23,403
Washington (total)	**$20,190**
Kelso	20,190
West Virginia (total)	**$2,190,609**
Elkins	175,352
Fairmont	71,445
Hundred	24,221
Kingwood	63,655
Morgantown	221,161
Webster Springs	33,937
Wheeling	1,595,838
National Total	**$11,974,974**

SIKORSKY AIRCRAFT ACHIEVEMENTS FOR 1935

Already the holder of ten world's records for performance, the Sikorsky S-42 gave outstanding proof of its capabilities by the successful demonstration of a practicable route across the Pacific for Pan American Airways.

The Sikorsky S-43 proved in actual performance to be the fastest transport amphibion flown in 1935, and is making its debut in scheduled service over the routes of Inter-Island Airways of Hawaii.

SIKORSKY AIRCRAFT
BRIDGEPORT CONNECTICUT

DIVISION OF UNITED AIRCRAFT MANUFACTURING CORPORATION, EAST HARTFORD, CONNECTICUT

G.H.Q. for Miami Meet

Big Air Corps force to feature this year's southern classic.

AL WILLIAMS, Clem Sohn, The Three Men on the Flying Trapeze, a troupe of comics who call themselves the Three Mugs of Beer—the program for the 1935 Miami Maneuvers promises as many headliners as were present at this fall's national affair at Cleveland's municipal airport.

More important, the eastern arm of the G. H. Q. Air Force will finish two weeks of maneuvers over Florida by a visit to the races scheduled for Dec. 12-13-14. Some 75 National Guard planes from nearby states are also expected. Grandstand accommodations for 15,000 have been prepared.

The three-day program features a wide variety of races for C licensed ships, four free-for-all races with displacement limitations only, and a women's handicap race. Prize money totals $5,000.

Up Balloon

Captains Stevens and Anderson set new altitude record.

AT 10 a.m. Nov. 10, the meteorologists attached to the Air Corps-National Geographic expedition informed Capts. A. W. Stevens and Orvil A. Anderson that their tedious two months' wait for weather good enough for a stratosphere flight was at an end. Three hundred cavalrymen from Fort Meade were summoned to the bowl-like valley at Rapid City, S. D., to help with the inflation, that was started that evening. By midnight the ship's quarter-million cu.ft. of helium had been piped into the huge envelope. A short rip appeared in the bottom panels but was successfully repaired.

By 7 a.m. all was ready. The two captains dressed in heavy flying suits, football headgears and harness for quick-attachable parachutes stepped into the tiny monel-metal globe. Thousands of spectators had gathered to watch the takeoff. The ship climbed swiftly, 800 lb. light, cleared the high cliff-like walls of the valley by 50 ft. At 15,000 ft. the ascent was stopped until a number of instruments could be rigged on lines below the gondola. Then the hatches were sealed and the climb was resumed. At 11 a.m. the objective height of 73,000 ft. was reached at a point over the Niobara River in northern Nebraska.

Readings went on steadily. The effects of great altitude upon photography, radio, cosmic rays, spore distribution, atmospheric composition, and the spectral distribution of sunlight were studied. For more than an hour the stratostat, now a huge spherical bag of 3,700,000 cu.ft. content, remained at its new record height.

Then slowly it began its long descent. At 25,000 ft. the crew began dropping ballast to hold the rate of descent to 500 ft. per minute. At 1,500 ft. that rate was cut to 100 ft. per minute, then to 50. A drag rope went over. A few feet off the ground Capt. Stevens pulled the rip cord. The gondola touched gently, then made a slow quarter roll onto its side. Nothing had been injured.

Officials of the National Geographic Society which had sponsored the flight were jubilant. Not once during the flight had the slightest flaw appeared in the Goodyear-rubberized Wellington-Sears fabric. Not an instrument had been lost or damaged. The final N.A.A. approved altitude of 72,395, beat the former unofficial Soviet mark of 72,176 by a small margin, and was over 12,000 ft. higher than the F.A.I. record held by Settle and Fordney.

A MERE 250,000 CU.FT.
of helium was put into the stratostat Explorer II before takeoff for its new altitude record. At 73,000 ft. it filled the great bag of Goodyear-rubberized Wellington-Sears fabric out to a sphere of 3,700,000 cu.ft. content.

Two Are Missing

Kingsford-Smith and Ellsworth disappear on record-seeking flights.

LAST month two great pioneers in aviation lost touch with civilization under circumstances to cause the greatest concern for their safety.

Both had long records of aeronautical achievement behind them. Both, a fact which bolstered the world's hope, had been missing before under somewhat similar circumstances.

Sir Charles Kingsford-Smith held more trans-oceanic records than any other flier. He had been first to fly from California to Australia, first to make the return journey. He had been second to make the westward crossing of the Atlantic. In his battered Fokker tri-

CONSTANT SPEED
Control
FOR ALL FLIGHT CONDITIONS

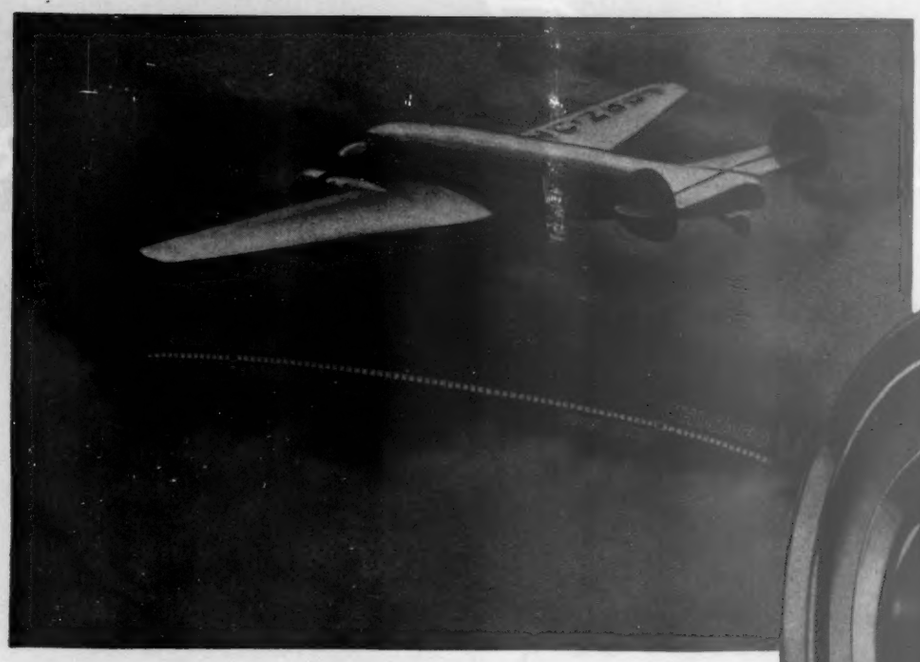
On September 4th, 1933, James R. Wedell set a world's land plane speed record of 304.98 m.p.h. using a Hamilton Standard controllable pitch propeller. On September 13, 1935, Howard Hughes restored world leadership to America with a speed of 352.46 m. p. h.* using Hamilton Standard's latest development—
The Constant Speed Propeller.

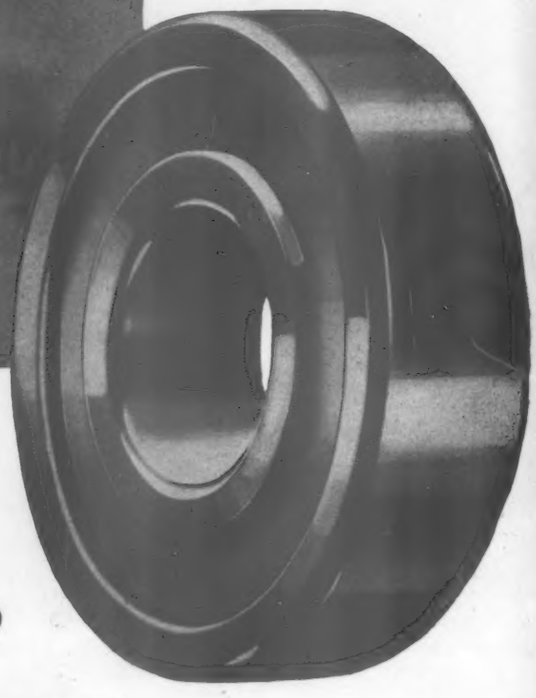
HAMILTON STANDARD PROPELLERS

East Hartford — Connecticut

*Subject to official homologation

DIVISION OF UNITED AIRCRAFT MANUFACTURING CORPORATION





40 *below or* 100 *above . . .*

No difference to FAFNIRS

The new twin-engine Lockheed Electra and the single-engine Orion, of the fleet operated by *Northwest Airlines, Inc.*, are Fafnir-equipped. Aileron hinges, elevator hinges, rudder hinges, control columns and cable pulleys feel "substantially the same as when new, after many hundreds of hours of flying time," according to Mr. K. R. Ferguson, General Traffic Manager of this northern transcontinental air route connecting Chicago with Seattle via Twin Cities and Spokane. "The use of these ball bearings has considerably reduced greasing and maintenance problems as well as repairs to these parts.

"In the case of one route through the northern tier of States, our equipment is subjected to extremes of temperatures ranging from more than 100° F. in summer to as low as 40° below zero in winter. In spite of these extremes, these Fafnir Ball Bearing-equipped controls function perfectly under all conditions," adds Mr. Ferguson.

The experience of the *Northwest Airlines* has been duplicated by many other leading airplane companies. Fafnir was the first to develop ball bearings for control surfaces, and their stored-up experience is available today, to enable you to operate with friction losses reduced to a minimum. Consult the Fafnir Bearing Company, Aircraft Division, *New Britain, Conn.*. . . . Atlanta . . . Chicago . . . Cleveland . . . Dallas . . . Detroit . . . Kansas City . . . Los Angeles . . . New York . . . Philadelphia.

Fafnir's Aircraft Booklet,* "BALL BEARINGS *for* AIRCRAFT", *describes the complete line in every detail. Copies are yours for the asking. Write us today.

FAFNIR BALL BEARINGS

motor the Southern Cross he had circled the globe. He had set a solo record from Australia to London.

Nov. 4, he left London with a companion, J. T. Pettybridge, in his Lockheed, Lady Southern Cross, to attempt to lower the London-Australia record. The two made excellent time to Baghdad, then to Allahabad. Off the coast of the Malay Peninsula they ran into a severe typhoon. C. J. Melrose, himself aiming at the solo record, caught a glimpse of the Lockheed battling through the storm a mere 200 ft. above the water some 150 miles from the coastline. No trace has since been found.

Lincoln Ellsworth had been with Amundsen on the first attempt to explore the Arctic by plane in 1925, and again in the following year on the first airship flight to the North Pole in the Norge. Last year he had led an unsuccessful expedition to the Antarctic, proposing to fly across a wide stretch of unexplored territory there.

Last month his base ship, the Wyatt Earp, nosed through the pack ice to find a take-off site practicable for his Northrop Gamma on Dundee Island 2,400 miles from Byrd's old base at Little America. Ellsworth and his Canadian pilot, Herbert Hollick Kenyon, proposed to fly to Little America and wait there until their base ship under command of Sir Hubert Wilkins would call to pick them up.

Twice during the third week in November they took off but were forced back, once by a fuel gage failure, once by bad weather.

On Nov. 23, they started again. For eight hours radio reports told of good progress. At that point the signals became unintelligible, then stopped. The base ship could not tell whether the radio alone had failed or the ship cracked up. No word had been heard from the explorers days after the take-off, when this issue of AVIATION went to press.

Soviet Heights

Russian flier beats F.A.I. airplane altitude mark

ON Nov. 21, a single-engined, single-seat biplane took off from Moscow's airport carrying 31-year-old Vladimir Kokinaki, once a sailor and stevedore, now test pilot for the Soviet Air Force.

A few minutes more than an hour later the ship reappeared, spiralling in toward a dead stick landing. Pilot Kokinaki climbed stiffly from the cockpit peeling out of his face mask and bulky flying suit.

The next day Soviet papers announced a new hero. A check of Kokinaki's barograph revealed he had reached 47,818 ft., 464 ft. higher than Commander Renato Donati's current F.A.I. record.

But Donati's record still stands in most countries. Russia has never become a member of the Federation Aeronautique Internationale.

Financial

United Airlines reports a profit, American a loss. General Motors sells TWA control.

▶ UNITED AIRLINES, for the quarter ended Sept. 30 reported a net income of $304,565, equivalent to 29.2 cents a share on outstanding stock. For the nine months ended Sept. 30 a net loss of $15,041 was shown.

▶ Working control of TWA, INC., transferred last month from General Motors to Lehman Brothers and Atlas Corporation, the country's largest investment firm. The latter firm purchased the entire General Motors block of 81,204 shares, 13 per cent of those outstanding.

▶ Pending hearings on allegations that the registration statement filed for a proposed issue of BELLANCA AIRCRAFT stock included "untrue statement of material facts" and "omitted to state material facts" and that Michael J. Meehan, head of a New York stock exchange firm had been manipulating Bellanca stock on the New York Curb Exchange, the S.E.C. has under way a stop order against the new issue.

▶ AMERICAN AIRLINES, INC. reported a net loss of $397,545 for the nine months ended Sept. 30.

Operating revenue	$4,367,805
Operating expenses	3,916,829
Depreciation	838,388
Net Loss	397,545

Side Slips

By Robert R. Osborn

ICE forming on the windshield of his 400 lb., one-piece airplane forced Edward W. Stitt of Bladensburg, Md., to land today at nearby Woodville, interrupting an attempted distance record flight from Davenport, Iowa, to Washington."—Clipped from the Washington (D. C.) *Star*.

When ice starts forming on the ship one is entitled to feel proud of getting it down in one piece.

WE are glad to see Mr. Ellsworth busy at his Antarctic exploring again. We don't know him personally but from his appearance and actions he must be a very acceptable individual,—and the fact that he is in a position to finance his own expeditions gives him a great advantage, so far as giving names to new territories, mountain ranges or water passages he discovers is concerned. Having always been a great admirer of Wyatt Earp, the famous marshal of three of the toughest towns in the old West, we heartily approve of that name for Mr. Ellsworth's supply ship, and, with Mr. Ellsworth selecting the names of his own discoveries, we need have no fear that future generations will be puzzled by names like Krispy Krunchy Breakfast Food Mountains, or Frostproof Mattress Plateau.

As we go to press the first Martin boat is about to start on the official opening of the new Pan-American service across the Pacific, and we are told that Mr. Farley will be present to press a button just as the first ship leaves the water—the button to flash lights in all of the post offices throughout the land signalizing that the air mail to the Orient has begun. Another high-light of the program will be that a stagecoach load of mail will arrive beside the waiting plane to demonstrate the progress in transportation of the mail in only a few years. We do hope that someone thinks to place a large sign on this stagecoach telling just what it is supposed to symbolize and demonstrate,—otherwise some of the crowd may think of it as indicating the probable method of carrying the mail in the near future, if the present attitude toward the airlines is to continue.

IN commenting on the starting of the Trans-Pacific air mail service, one writer in a Washington paper speculates on the antecedents of the name "Clipper Ship." We quote from his article,—"For many, it may be supposed, the historical background of the occasion will be interesting. No one, lexicographers say, has found the origin of the phrase 'clipper ship.' Some authorities believe it may be traced to the expression 'go at a clip' signifying 'run fast, as a horse.' Others declare it comes, much more directly, from the German word 'kleppen' meaning 'moving swiftly'."

Inasmuch as the origin of the name seems to be in doubt let's assign an arbitrary parentage to it. Let's say that it means "To make real progress, in spite of governmental interference," or "To go faster, with the help of a lot of horses from the engine manufacturer."

Schools, Services, and Airports

● ALABAMA—Capt. John Donaldson, National Guard flyer and operator of the Donaldson Flying Service at BIRMINGHAM, was named State Director of Aeronautics at the organization meeting of the Alabama Aviation Commission held Oct. 23 in MONTGOMERY. Harry King who has operated a repair shop at the BIRMINGHAM airport for the past two years has taken over Captain Donaldson's company.

● ARKANSAS—Nine planes of the eighth annual Arkansas Air Tour landed at MEMPHIS on Oct. 13. They visited fields in east Arkansas and reported all in excellent condition due to CWA and ERA aid. Their visit to PORTLAND was made the occasion for the dedication of the new airport in that city.

● CALIFORNIA—A survey in connection with a movement to rid Northern California airports of dangerous high-tension lines, reveals that of 36 fields only seven are free from such hazard. . . . Anticipated improvements at MERCED airport, from WPA funds, will qualify it as a night landing field. . . . Plans for a cross-runway at Clover Field, SANTA MONICA, have been approved by the Department of Commerce. Paul J. Birkofer, formerly with Northrop company, has been added to the teaching staff of the aeronautics department of Chaffey Junior College. . . . SANTA BARBARA officials believe that the improvements being done by Santa Barbara Airways at Goleta airport will place it in the ranks of the best privately-owned airports in California. . . . STOCKTON's municipal airport will continue under a temporary lease arrangement until the first of the year, after which the fate of the field will be decided by the City Council.

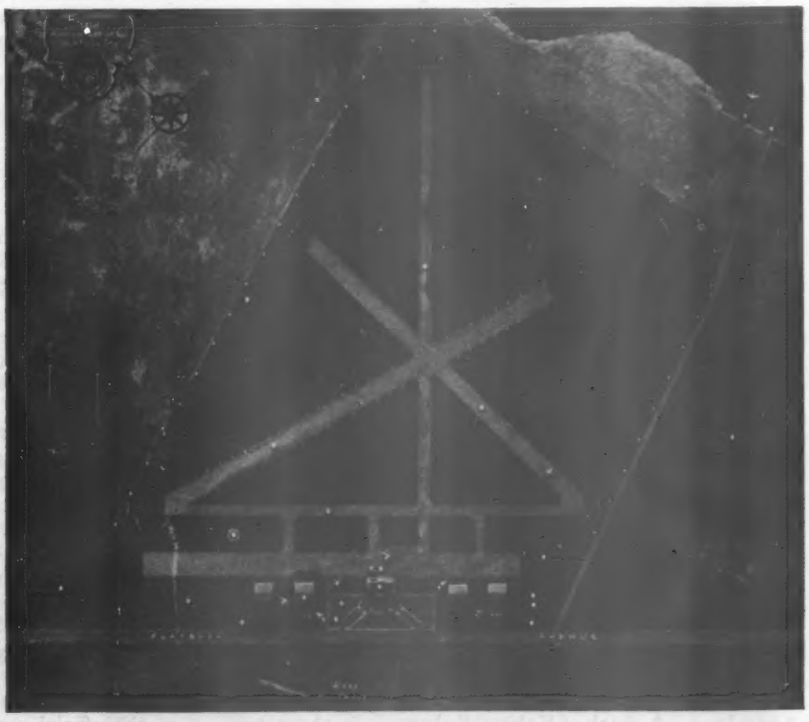
● COLORADO—Lieut. Ray Wilson, formerly with the 120th Observation Squadron, Colorado National Guard, recently reopened the former Curtiss-Wright flying field at DENVER. Five ships are already hangared there. The 120th Observation Squadron, commanded by Maj. Virgio D. Stone, participated in airshows held in October at Alexander Field, COLORADO SPRINGS, and at the DENVER Municipal Airport.

● CONNECTICUT—C. B. Whittelsey of the HARTFORD Chamber of Commerce has presented to the War Department at Washington full data concerning the availability of the municipal airport as an Army air base. . . . The guarantors who have taken back the Mollison airport (STRATFORD) property on a foreclosure have announced they will close the field Dec. 15. . . . Improvements to local airports at MERIDEN, DANBURY and GROTON have been recommended to WPA. All three developments call for drainage, resurfacing, and enlargement of flying areas.

● DELAWARE—On Oct. 17 a fire destroyed the hangar and airplane shop of Air Service, Inc., on the Bellanca Field near NEW CASTLE. Quick action by George Denn saved twelve planes. Immediate plans for construction of a new hangar were announced by R. D. Morgan, president of Air Service, Inc.

● FLORIDA—R. V. Waters was re-elected president of Greater MIAMI Airport Association for the seventh consecutive time on Oct. 24. . . . Dr. Cesar Grillo, director of Aeronautics of Brazil, and Louis Marques, director of civil aviation in Uruguay, stopped off in Miami before returning to their own countries on the conclusion of their tour of the United States during Air Navigation Week. . . . Kiwanians of TAMPA heard Jerome A. Waterman, chairman of the aviation committee of the Chamber of Commerce, on air line travel recently. . . . A discussion of National Air Defense by Maj. R. W. Cushman featured the October meeting of the JACKSONVILLE Pilot Club.

● GEORGIA—MACON's City Council has approved the purchase of 250 acres for a new municipal airport. Work will begin at once under a federal allotment of $107,338. Application is pending for an additional $69,000. Airmail and passenger service, suspended because Eastern Air Lines' new planes could not land and take off at Miller Field, will be restored to Macon as soon



A MODEL AIRPORT

made in facsimile of Floyd Bennett Field as it will be when the extensive WPA improvements now in progress are finished. The mile-long diagonal runways will be important additions, as will the blind landing lights shown along the border of one of them.

It is a tribute to the airplane industry that wing construction now matches the modern bridge in reliability.

(ADV)

NATIONAL PACIFIC

AIRCRAFT & BOAT SHOW

1936 AVIATION PREMIERE

Take leadership in the awakening and rapidly expanding market for all products and services of the aircraft industry.

Participate with the Nation's outstanding aircraft, engine and accessory manufacturers in this mammoth, colorful and all-embracing inaugural presentation of the new 1936 creations—enhanced by the addition of water craft that will substantially add to the public appeal. Share the benefits to be derived from the truly great western market to which it will primarily cater. The entire industry will be there.

The magnificent new Pan-Pacific Auditorium in the heart of uptown Los Angeles' business center furnishes the setting. It is admirably designed for luxurious aircraft arrangements at moderate cost. Its 110,000 square feet of exhibit space affords display of large craft without crowding. A 60-foot service door permits placement of completed craft without dismantling.

Here manufacturers, distributors, operators and executives in every department of aviation will be in attendance. *For further details write Clifford W. Henderson, managing Director, 7600 Beverly Blvd., Los Angeles.*

Sponsored by CALIFORNIA AIR INDUSTRIES, ASSN., LTD.

LOS ANGELES

FEB. 1 TO 9

as the new field is in condition for traffic. . . . Ben Epps, M. N. Tutwiler and Col. H. E. Mann were appointed by the CLARKE COUNTY Board of Commissioners to represent both the county and the city of ATHENS in negotiations connected with the development of the airport. . . . Phillips Moore, D. of C. airport advisor for Georgia and Florida, will supervise the building of eight new airports in Georgia's aviation system, to be located at BRUNSWICK, STATESBORO, QUITMAN, MACON, SWAINSBORO, WINDER, WACO and EASTMAN. The program also includes improvement of fields at LAVONIA, MOULTRIE, THOMASVILLE, ATHENS, ALBANY, GRIFFIN, CORDELLE, and DOUGLAS. . . . Southern Airways has launched a new air school at Hunter Field, SAVANNAH. F. O. Miller of AUGUSTA has been appointed manager. Miller has served as pilot for Pan American and more recently as operator of a school at Rocky Mount.

● ILLINOIS—Decision of the DECATUR Air Service, Inc., to retire from business on the expiration of its sublease of Decatur Airport recently threatened the continuance of that field. After the submission of a bid by Paul C. Temple, development engineer for A. W. Cash Company, however, it was decided to maintain it for the use of private planes. . . MOLINE City Council has entered into a temporary contract with Bernard Suverkrup, Moline airport manager, for operation of the municipal field pending the time when the city will be in position to offer a long term contract to United Air Lines. . . . Cooperating in the removal of hazards at CHICAGO's municipal airport, the Commonwealth Edison Company has agreed to bury all its power lines at the ends of runways. The Chicago Surface Lines also agreed to bury feeder lines and to lower its trolley wires. . . . Raymond McNeill is building a hangar at the DANVILLE municipal airport. . . . Harold Neumann returned to MOLINE after a trip to Chicago, where he purchased a Travelair (J-5) for sky-writing. An airshow staged at the Moline Municipal Airport in his honor on Oct. 13 was attended by some 20,000 people. Milo Burcham and Dick Granere participated. . . . The Illinois Aeronautics Commission, under the direction of Elwood B. Cole, secretary, started a goodwill air tour of central Illinois airports on Nov. 1.

● INDIANA—A commercial air field and flying school has been opened by the O'Neal Aircraft Company of VINCENNES at BEDFORD. C. W. Fellers will be in charge. . . . City Councilman Howard L. Chambers has recommended that SOUTH BEND purchase outright the Bendix municipal airport property to become eligible to receive federal funds sought for paving, grading and tiling, and construction of a new hangar. Vincent Bendix, Bendix Aviation, president, has offered to contribute $18,000 for the purchase of materials, thus making possible the improvement program without cost to the city.

● IOWA—SIOUX CITY seeks to convert Rickenbacker Field into a municipally owned airport to make it eligible for federal funds, but is stymied by the fact that the field is actually located in South Dakota. The field, now owned by Hanford Airlines, would be leased to that company by the city if the plan materializes.

● KANSAS—Albert Plesman, managing director of Royal Dutch Airlines stopped off recently in WICHITA during a trans-continental tour of inspection of aviation in the United States. . . . National Guard maneuvers at Santa Fe brought sixteen army planes to the WICHITA airport for a brief visit on Oct. 27. . . .Local aviators of HUTCHINSON put on an airshow at the municipal airport on Oct. 20. In mid-November, members of the newly formed Hutchinson Aviation Club, moved their planes to the WICHITA airport in protest over the condition of the field.

● KENTUCKY—Wright Airlines, Inc., was incorporated in October to establish an air line from LEBANON to LOUISVILLE, touching CAMPBELLSVILLE, COLUMBIA, GLASGOW, BOWLING GREEN, HOPKINSVILLE and OWENSBORO. The line has been incorporated for $15,000 with W. C. Wright as president. Two new Stinsons will be used.

● LOUISIANA—Third Wing, G.H.Q., U.S. Air Force, established its base at Shushan Airport in the maneuvers for the "defense" of NEW ORLEANS against an air "foe." Colonel Brant declared that Shushan would "unquestionably be a base in wartime." . . . The NEW ORLEANS Aviation Club staged an air meet at Shushan Airport on Oct. 20, awarding prizes for spot landing and bomb dropping.

● MAINE—BIDDEFORD officially opened its new airport on Oct. 11, although work has been temporarily suspended because of lack of state funds. Tex Rankin, well known Pacific Coast operator, turned up at an air meet held at the Portland municipal airport at STROUDWATER in October. He has been on an extended tour of the country's airports demonstrating the new Menasco-powered Ryan sport plane built in San Diego.

● MASSACHUSETTS—C. & W. Flying Service, with H. B. Wetherill as chief pilot, is now operating at GARDNER airport. Student instruction, charter work and passenger flying are offered. . . . At a meeting of the BROCKTON Aeronautical Association a resolution was passed that any action on the part of the city or government toward leasing the local airport for the use of the city be protested. . . . The SPRINGFIELD Airport and Aeronautical School has been designated as an approved repair station by the Bureau of Air Commerce. Howell W. Miller is in charge of the shopwork, and Clarence Washburn, chief pilot, is supervisor of operations. . . . An aero club is being organized at LAWRENCE. . . . Members of the Smith College Flying Club will receive flying instruction from Donald Hood, pilot at La Fleur airport, and will use the Taylor Cub recently purchased by the Amherst College Flying Club. . . . The NORTHAMPTON Flying Club has announced plans to purchase its own plane. . . . Allotment of $20,000 WPA funds is being sought by the aviation section of the state public works department for painting air markers.

● MICHIGAN—H. A. Pollock of JACKSON has been elected president of the Non-Commercial Aviation Association of Michigan. . . . FLINT's unique solution toward making Bishop airport facilities adequate for increased traffic is the use of bricks removed for the re-paving of a downtown street for lengthening and widening the runway and the construction of a new hangar. Improvement of the lighting system is being discussed. . . . The Chamber of Commerce of SAULT STE. MARIE has passed a resolution urging its municipal airport be considered for one of the Air Corps' new bases. . . . All Michigan observed Air Navigation Week by holding open house at its airports. . . . Rel K. Branch, president of Kent Flying Club, GRAND RAPIDS, has been appointed a member of the national committee on aviation of the United States Junior Chamber of Commerce. . . . Tracy Southworth, recently assigned by the state aeronautical department to supervise airport development work in the Upper Peninsula, while on a visit to Marquette inspected the new airport near NEGAUNEE.

● MINNESOTA—The U.S. Naval Reserve aviation squadron, stationed at MINNEAPOLIS, may establish a two-week base at DULUTH next August, looking toward the establishment of a permanent naval reserve sub-base either on Minnesota Point or at the Williamson-Johnson municipal airport.

● MISSISSIPPI—The airways division of the Department of Commerce has established a storehouse and supply depot at BILOXI with J. C. Hollingsworth, formerly with Miami-Atlanta Airways, in charge. . . . The University of Mississippi is to have its own airport under the new, recently approved state-wide airport program. . . . Senator Bilbo, Congressman Dunn and the Key Brothers were on the program of NEWTON FALLS' air festival held Nov. 11.

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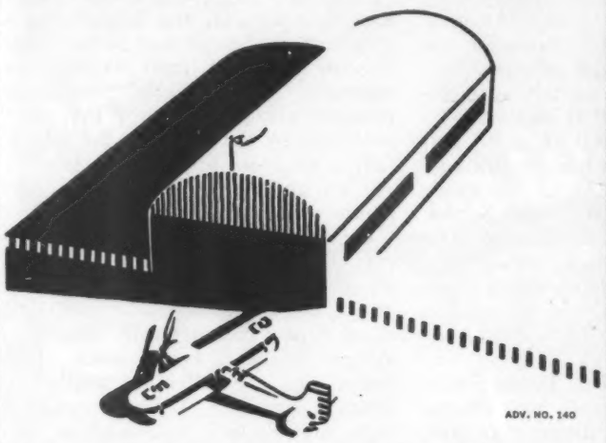

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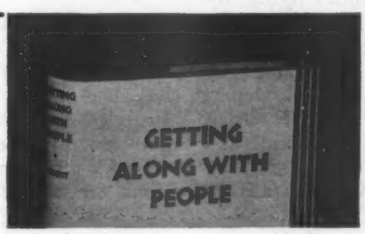

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● MISSOURI — Robertson Aviation School, operating at Lambert Municipal Airport, ST. LOUIS has added Lieut. J. W. Geppert and Walter R. Kirsten to its teaching staff. . . . The City Council of KANSAS CITY has appropriated $24,970 for construction of a two-story addition to the TWA building at the airport. . . . The city of ST. JOSEPH is moving toward the purchase of a 400 acre tract for a new airport near French Bottoms.

● MONTANA—Both Three Forks airport at GREAT FALLS and the MISSOULA airport have had new lighting equipment installed. . . . Dillard Hamilton, formerly of BUTTE, has been placed in charge of the aviation department of the University of Illinois.

● NEBRASKA—Plans have been completed for a $500,000 improvement of the OMAHA municipal airport, including runways, lighting system, a roadway, and an enlargement of the present loading apron. . . . LINCOLN'S City Council has amended the municipal aircraft ordinance to make excessive airplane noise a law violation.

● NEW HAMPSHIRE—W. R. Murphy of Manchester has opened a mechanics school at the municipal airport in NASHUA. . . . Edward H. Spooner of CLAREMONT, active in aviation since 1929, has been appointed to direct WPA projects at New Hampshire airports, specifically the improvements to be made under the $51,239 grant to MANCHESTER and the $48,881 grant to CONCORD.

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THE FIRST

high school trained pilot to receive a private license is William Robertson (left) who completed his training recently in the Teaneck, N. J., High School Aeronca. His instructor, A. G. Norwood (right), has several other students who have completed their 50-hour requirements and will soon follow.

● NEW JERSEY—Occupancy of the administration building at NEWARK airport has been delayed until enough of it is finished to afford space to all airlines desiring to use it. . . . Appraisers have assessed the value of additional land sought for the Newark airport at half the total of $130,000 asked for it by the owners. . . . An air show staged at JERSEY CITY airport in an effort to save it from being used as a site for a civic stadium featured a streamer strung from a plane reading "Save the Jersey City Airport."—The Flying Clubs of America and the Aeronautical Association of Hudson County have also protested. . . . A cotton reenforced asphalt surfaced runway will be installed at NEWARK airport as part of the $3,000,000 WPA improvement program on which work will start in the spring. . . . A. G. Norwood, instructor in the TEANECK High School flying course, has assumed temporary managership of Murchio's airport near PATERSON. The airport operating company is awaiting delivery of a new Taylor Cub.

● NEW MEXICO—The Young-Smith Air Service, which recently took charge of the ALBUQUERQUE airport, has purchased a tri-motored Fokker for charter work. E. W. Brown is chief pilot.

● NEW YORK—In a demonstration of the safety of cross-country flying, fifteen airplanes flown by members of the ROCHESTER Pilot's Association carried 50 passengers, including the mayor of Rochester, from the municipal airport to DANSVILLE and return late in October. . . . An administration building and two new hangars, to cost about $203,000, will be added to BUFFALO airport if present WPA plans carry through. . . . Fire swept the hangar at NIAGARA FALLS municipal airport on Oct. 28, destroying eleven planes. . . . NEWBURGH'S airport, now known as Stewart Field, has been deeded to the government for a military airport, with the proviso that the ctiy may retain 5 acres for a municipal hangar. . . . John J. Sullivan has been elected president of the newly organized SYRACUSE Aeronautical Association. . . . Major W. F. Brooks of Holmes airport, will establish his own flying school at the old Knickerbocker aviation office, FLUSHING airport. Joe Rock of Vermont will teach the students. . . . Dedication of the intermediate landing field and government weather station at FORT PLAIN airport on Oct. 7 was witnessed by more than 10,000.

● NORTH CAROLINA—The CHARLOTTE airport was closed to military, commercial, and private aviation from Nov. 1 to 15 because of hazards existing during the construction of a track for automobile races. An air show held at the port in October brought scores of aviators from nearby states as contestants for prizes awarded by the Carolina Aero Club. . . . Robert F. Dilling of Charlotte has been appointed co-pilot for Eastern Air Lines on the Atlanta to Chicago run.

● OHIO—AKRON'S action in seizing the hangar of Air Services, Inc., for $5,000 back rent has been characterized as "arbitrary and confiscatory" by R. F. Kitchingman, president of the company, in a letter to stockholders. . . . Although $75,000 has been expended by CWA and FERA on improvements to LIMA'S municipal airport, the Department of Commerce has ruled that airliners must not use the port until hard-surfaced runways, proper lights, water and hangars are provided. WPA aid is precluded by the fact that the city has only a five-year lease on the site. . . . An air show presented by the Aeronautic Association and Chamber of Commerce at HAMILTON airport in October drew 10,000 spectators. Tex Rankin and Harold Neumann were among the performers. . . . Dedication of the new aeronautical museum at Wright Field, DAYTON, with special honors to the Wright brothers, is planned for Dec. 17, anniversary of their first flight. . . . Sundorph Aeronautical Corporation, operating at the CLEVELAND Municipal Airport, is now Cessna dealer for all territory east of Indiana.

● OKLAHOMA—Now that OKLAHOMA CITY'S $135,000 application for improvements at the municipal airport has had Washington's approval, Bill Bleakley, manager of the port, and city and federal officials plan to level the west side for student and army operations, extend the main runway to a full mile, install night landing lights, and construct hangar-quarters for the Army Air Reserve unit and a combination hangar-factory for Wiley Post Aircraft Corporation.

● OREGON—Tex Rankin has been elected regional vice-president of the National Association of State Aviation Officials for Oregon, Washington and Idaho. . . . The SWAN ISLAND airport has failed to pass the Department of Commerce requirements for heavier air traffic, the department recommending that a new site be considered. Meanwhile a commission, headed by Harry K. Coffey, and including 125 members of the Aero Club of Oregon, has been formed to conduct a drive for an airport to cost $1,000,000 to $3,000,000. It favors a plot of land 1½ miles southeast of Rocky Butte and 2 miles northwest of Gresham for the new site. . . . P. F. Helmer, district WPA engineer, has approved Moon Island as the logical site for an airport for GRAYS HARBOR COUNTY.

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● PENNSYLVANIA—Flying instruction was resumed at the Splane Memorial Airport, OIL CITY, on Nov. 11. . . . Dr. S. C. Davenport and F. D. Senior, operators of the Patterson Heights Airport, BEAVER, have received a state license for their field. . . . LEIGHTON airport has been leased by Jacob Arner and Fred Getz, who will specialize in aerial advertising. . . . A pilots' club, limited to employees of Taylor Aircraft Company, was organized at BRADFORD in October. . . . Upon the assurance that a regular airline passenger schedule will be maintained at Wyoming Valley Airport, WILKESBARRE, connecting with other lines throughout the country, city and county officials have cooperated in securing options for leases upon additional land required for a 3,690 ft. runway. A WPA project for completion of field grading is now in progress at the port. Improvements scheduled include installation of a lighting system and construction of additional hangars.

● RHODE ISLAND—Dr. Igor Sikorsky, who holds the rank of professor of aeronautical engineering at Rhode Island State College, spoke to the newly formed Aero Club of the college Oct. 17 on future oceanic plane service. . . . A $300,000 federal grant for construction of hangars at the remodeled state airport in HILLSGROVE awaits approval of the State Emergency Public Works Commission. Acceptance of the field, completed as a $400,000 relief project, has been delayed by the Department of Commerce awaiting settlement of litigation over the lighting contract.

● SOUTH CAROLINA—Beverly Howard, of CHARLESTON, Oct. 30, came within 2,000 ft. of breaking the world's record for a two-seated light airplane reaching an altitude of 16,000 feet in an American Eaglet. . . . Grading is soon to begin at GREENVILLE municipal airport as the first step in the $238,516 WPA development program. . . . At AIKEN, too, work has started on the $16,000 improvements planned at the municipal airport.

● SOUTH DAKOTA—Work was started in October on HURON's $76,000 airport improvement program, with a force of about 50 men. . . . At BROOKINGS, too, work has started on the new hangar, eighteen men reporting on the job. . . . Plans to improve facilities at Soo Skyways airport with a WPA grant were discussed at a meeting held in SIOUX FALLS Oct. 30.

● TENNESSEE—Webb Kimbale, acting manager of Lovell Field, CHATTANOOGA, recently received appointment as permanent general manager from Commissioner R. B. Cooke. . . . High voltage power lines skirting the west side of the proposed Knoxville-Maryville-Alcoa airport must be moved before the government will give final approval to the project. City officials report that American Airways has agreed to make Knoxville a station on its coast-to-coast route as soon as the new field is completed. . . . The fourth and final tract to be used as the site for upper East Tennessee's $500,000 Central Airport, was acquired on Oct. 22, and actual construction is expected to begin soon. The administrative and control board of the airport is composed of six members from JOHNSON CITY and two each from BRISTOL, KINGSPORT and SULLIVAN COUNTY. . . . JACKSON's new airport, under construction for more than a year with TERA labor, was formally dedicated on Armistice Day, with the 105th Observation Squadron of the Tennessee National Guard and fliers from Memphis and Montgomery, Ala., as invited guests.

● TEXAS—SAN ANTONIO has applied for approximately $77,000 federal funds for improvements at Winburn Field. . . . Diplomas and wings were received by 67 students of the Advanced Flying School, Kelly Field, San Antonio, on Oct. 13. An aerial demonstration marked the event. . . . A $126,000 PWA loan and grant for FT. WORTH municipal airport will be used for a new terminal building and installation of a new lighting system. Braniff Airways, Bowen Airlines, American Air Lines and Delta Air Lines are expected to take space in the new building. . . . Dee Graham, manager of Panhandle Flying Service, staged an air circus at PAMPA late in October. Fifteen planes took part.

● UTAH—Construction of beacon lights over the National Parks Airways route between SALT LAKE CITY and HELENA is under way. . . . The newly-chosen executive committee of the Salt Lake Chamber of Commerce Aviation Committee, W. E. Sutton, G. R. Corey and F. P. Reynolds, Jr., are investigating the need for improvements at the airport administration building. . . . Because OGDEN airport no longer meets requirements of the Army Air Service, and because there is no more land available to extend its boundaries, thereby making it ineligible for WPA funds, city officials are inspecting possible new sites.

● VERMONT—The citizens of MONTPELIER, at a special meeting held on Oct. 22, voted to issue $12,500 notes for the purchase of a half-interest in the Barre-Montpelier airport in Berlin. The federal government will allot $60,000 for development of the airport, and it is expected that work will start within a few weeks. The Boston-Maine-Central-Vermont Airways are to use the port for their Boston to Burlington transport planes.

● VIRGINIA—According to D. W. Alexander, inspector for the Bureau of Air Commerce, Shepherd landing field, near MARTINSBURG, will qualify for the proposed $75,000 tentatively allocated for improvements by WPA. The money will be used for a lighting system, grading and administrative buildings. . . . The development of a municipal airport in WINCHESTER as a relief project for which $4,438 WPA grant has been approved, may not be feasible because of lack of relief labor, the relief rolls in the county having been depleted because of activities in the fruit industry. . . . The new airport at Loving Field, PULASKI, will have two runways and a lighting system. . . . Dedication ceremonies at BLACKSTONE Municipal Field included the first official air show in Nottaway County. . . . One thousand people witnessed the air show held at Dew farm, near CLIFTON FORGE. . . . The airport at NEWPORT NEWS having been completed, its committee now seeks hangar facilities. The city has been assured of a considerable rental from plane owners in the vicnity.

● WASHINGTON—Incorporators of newly formed Olympia Air Transport Corporation, OLYMPIA, are H. A. Lincoln, F. F. Chitty, P. D. Loudi, W. B. McDonald and J. M. Robinson. The company is planning manufacturing as well as operating activities. . . . WALLA WALLA is expecting increased activity at its airport since leasing it to James Leachman and George Christensen, who plan to purchase a large cabin ship for charter service, and to offer student instruction. . . . H. G. Davenport has been named supervisor for the CHEWELAH airport project, toward which the city is supplying $1,373 and WPA $11,814. . . . A $1,000,000 project, whereby WHATCOM COUNTY and the city of BELLINGHAM will be provided with a modern airport, was submitted to WPA authorities on Oct. 25. The county has a tentative agreement for purchase at $12,000 of a 240 acre site bordering the Pacific highway a mile and a half north of the city limits.

● WEST VIRGINIA—The WPA grant sought for the municipal airport at CHARLESTON has been held up until the city has secured title to 40 additional acres. Preliminary negotiations have already been completed. . . . HUNTINGTON is having difficulty in finding a site for its new airport that will be acceptable to WPA authorities, thereby endangering receipt of the WPA funds tentatively approved if a site in Cabell County can be decided upon. . . . Preliminary work on MORGANTOWN's $227,000 municipal airport project was started on Nov. 6.

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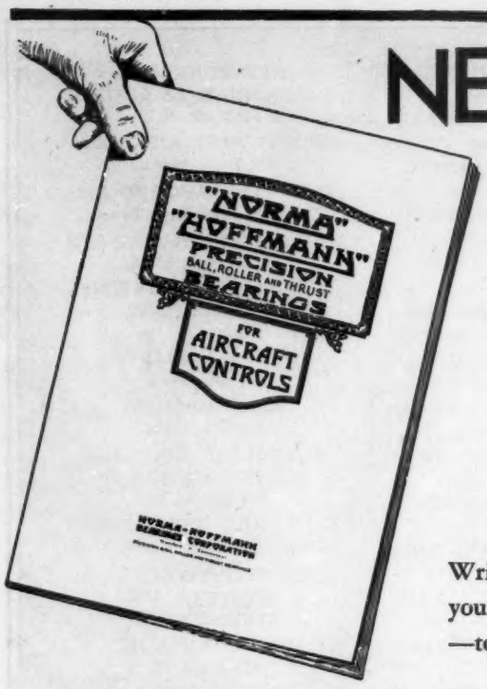

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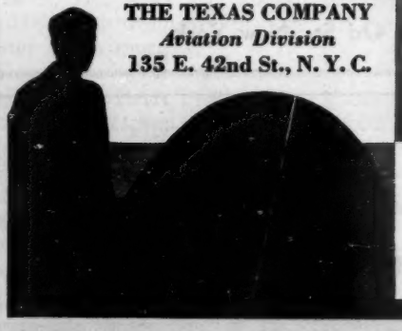

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• Election of J. B. BOND as executive vice-president and general manager of Berry Brothers, following the resignation of T. J. Campbell, former president, was announced at a recent meeting of the board of directors. Mr. Bond has heretofore served as assistant general manager and comptroller of the company.

• United Aircraft Corporation of East Hartford, Conn. elected HARRY G. STODDARD to its board of directors. Mr. Stoddard has been president of Wyman-Gordon Company of Worcester, Mass., since 1931, and was previously connected with Trenton Iron Company and American Steel & Wire Company. He is also president of the Worcester Telegram Publishing Company, and serves on the directorate of many New England organizations.

• ALFRED A. GASSNER has taken two months' leave of absence from his post as chief engineer of the military and transport division of Fairchild Aircraft Corporation in order to act in a temporary consulting capacity with Junkers in Germany. Mr. Gassner was for many years chief engineer of Fokker Aircraft Corporation.

• On Nov. 25 DR. STEPHEN J. ZAND lectured before the Royal Aeronautical Society in London on sound-proofing of aircraft. The speaker, whose work on noise elimination is well-known to the industry here, spoke on the development of sound proofing, and its technical aspects.

• United Air Line officials have announced the election of PAUL A. WRIGHT to the presidency of United Airports Company of California, to serve as general manager of Union Air Terminal. Mr. Wright was previously stationed in Chicago where he was secretary of United Air Lines Transport Corporation and assistant to President W. A. PATTERSON.

• The Lithuanian Government has conferred the Order of Vytautas the Great on FELIX WAITKUS, Wisconsin flyer who attempted a New York-to-Lithuania flight. More than 100 streets in Lithuanian towns have been named after him.

• Seven airmail flyers who have recently been awarded medals of honor by President Roosevelt for heroic achievements during the past year are

J. B. Bond

Harry G. Stoddard

A. A. Gassner

Stephen J. Zand

GORDON S. DARNELL, Kansas City; EDWARD A. BELLANDI, Hollywood; LEWIS S. TURNER, Fort Worth; JAMES H. CARMICHAEL, JR., Detroit; WELLINGTON P. MCFAIL, Murfreesboro; ROY H. WARNER, Portland; GROVER TYLER, Seattle.

• As of Nov. 1, E. S. RITCHIE & SONS, manufacturers of nautical instruments and aeronautical compasses at Brookline, Mass., became E. S. Ritchie & Sons, Inc. The company continues under the same management, with R. C. RITCHIE as president and treasurer.

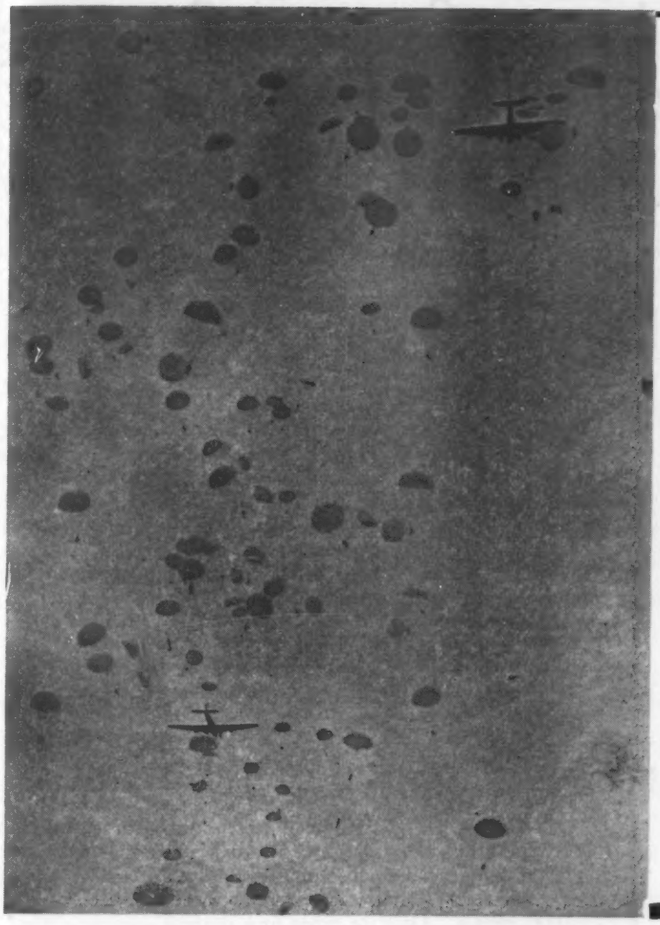
• The War Department has presented the Distinguished Fying Cross to Flying Cadet FRANCIS H. MACDUFF for heroism displayed in June, 1935. With his airplane in flames, Cadet MacDuff remained at the controls to maneuver it in such manner that his passengers were enabled to make successful parachute jumps to safety.

• GUY W. VAUGHAN, president of the Wright Aeronautical Company of Paterson, presented five, ten, and fifteen-year service pins to 900 employees of the company at a luncheon celebrating its sixteenth anniversary on Oct. 15. Those who received pins for fifteen years of service were: KENNETH J. BOEDECKER, ARTHUR NUTT, GUSTAF CARVELLI, WILLIAM HALL, CHESTER SHELLBERG, PERRY W. BROWN, AUSTIN A. SUNDAY, JOHN H. DARRAGH, JR., CHARLES C. KING, JAMES J. DONOHUE, IRVING J. GUNTHER, ALBERT A. TUMSER, MOIS F. GEMME, ARNOLD G. CARLSON, EDWARD J. MULLIGAN, ANDREW H. BARDES, WILLIAM VAN ASSEN, HERBERT BORGMAN, CECIL HARA, HERMAN F. KIEL, MINERVA CODAIRE, IDA B. MOORE, ANTOINETTE JEFFER, OSCAR B. MORHRING, JOHN A. QUEENAN, CHARLES O. HARRIS, WILLIAM J. LALLY, ROBERT C. HOWELL, JOHN N. NICK, JR., RALPH DEAN BARTOW, HERMAN W. BORNKAMP, HORACE F. RHODES, THEODORE TURNER, CHARLES DYMOCK, ALBERT BRIEGEL, FRANK STEHLIN, CHARLES J. LOMBAERDE, DAVID H. KEENER, EUGENE PLOUJOUX, ANDREW COOK, CURT VERSELL, EMILIO FAYGIO, CLYDE W. WHITWORTH, WILLIAM BINGHAM, CHARLES SLADE, HENRY E. DOBSON, MICHAEL J. BAIERL, ISAAC HARNED, HENRY SCHMIDER, IRVING PROVOST, IRA CURTISS and JOHN SMITH.

• The crash last month at Wright Field which destroyed the Boeing 199 bomber cost aviation two splendid flyers.

PLOYER P. HILL had been commissioned a Major in the Air Corps but a few months. Born 41 years ago in Massachusetts he had graduated from Brown University in 1916 and entered the Army Signal Corps Air Service during the World War.

LESLIE TOWER, chief test pilot for Boeing Aircraft, was regarded as one of the front ranking men of his profession. A native of Montana, he entered the Air Service in 1923, after three years at the University of Washington. Graduating from Kelly field in 1924 he entered the employ of the Boeing company, becoming chief test pilot two years later at the age of 24.



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1. **AVIATION HANDBOOK**, by Edward P. Warner, and S. Paul Johnston. 715 pages, 4½x7, illustrated..... $7.50
2. **THE AIRPLANE AND ITS ENGINE**, by Charles H. Chatfield and Charles F. Taylor, 443 pages, 5½x8, illustrated $3.00
3. **AIR NAVIGATION**, by P. V. H. Weems, 580 pages, 6x9, illustrated $5.00
4. **AVIGATION**, by Harvey H. Holland, 272 pages, 4½x7, illustrated $2.50
5. **AEROLOGY**, by Charles J. Maguire. 186 pages, 6x9, illustrated $2.50
6. **AERIAL AND MARINE NAVIGATION TABLES**, by John E. Gingrich. 64 pages, 7x10½..... $2.50
7. **APPLIED WING THEORY**, by Elliott G. Reid. 231 pages, 6x9, illustrated..... $3.00
8. **AIRCRAFT PROPELLER DESIGN**, by Fred E. Weick. 294 pages, 6x9, illustrated..... $4.00
9. **FUNDAMENTALS OF HYDRO- AND AEROMECHANICS**, by L. Prandtl and O. G. Tietjens. 270 pages, 6x9, illustrated $4.00
10. **APPLIED HYDRO- AND AEROMECHANICS**, by L. Prandtl and O. G. Tietjens. 315 pages, 6x9, illustrated..... $4.00
11. **AIRPLANE CONSTRUCTION AND REPAIR**, by John E. Younger. 433 pages, 5½x8, illustrated..... $3.00
12. **THE AIRCRAFT MECHANICS' HANDBOOK**, by I. W. Miller. 174 pages, 4½x7, illustrated..... $2.00
13. **MARKS' MECHANICAL ENGINEERS' HANDBOOK**. 2264 pages, 4½x7, fully illustrated..... $7.00
14. **RADIO ENGINEERING HANDBOOK**, Editor-in-Chief, Keith Henney. 583 pages, 4½x7, illustrated..... $5.00
15. **RADIO OPERATING QUESTIONS AND ANSWERS**, by Arthur R. Nilson and J. L. Hornung. 389 pages, 5½x8, illustrated $2.50
16. **A HISTORY OF AIRCRAFT**, by F. Alexander Magoun and Eric Hodgins. 480 pages, 6x9, illustrated..... $5.00

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AIRPORT EQUIPMENT — **Rotating Beacons**

Bartow Beacons, Inc.,
1605 Walnut St., Philadelphia, Pa.

BARTOW Beacons differ from standard types in that they are completely spherical, have three separate lens systems, a doublet combination to produce high candle power beam at small angle to horizontal plane, a cylindrical fresnel lens to produce a lower candle power spread beam of small vertical divergence, and a ceiling lens throwing a concentrated beam upward. Lenses easily removable for maintenance. Rotating mechanism in weather-tight cases. Also manufactured under license by General Electric Company.

AVIATION, *December, 1935*

INSTRUMENTS — **Magnetic Compass**

Pioneer Instrument Company,
754 Lexington Ave., Brooklyn, N. Y.

NEW compact magnetic compass announced, the Type 864 (Navy Mark VIII). Card of float type suspended in glass bowl. Expansion and contraction of liquid handled by a bubble chamber vented to outside atmosphere. Card unusually light, easy to read and unaffected by reasonable vibration. Screw type compensator. Indirectly lighted from a 12-volt bulb. Overall dimensions $3\frac{1}{8}$x$3\frac{7}{16}$x$3\frac{7}{16}$ in. Weight, 1 lb., 8 oz.

AVIATION, *December, 1935*

MISCELLANEOUS — **First-Aid Equipment**

Davis Emergency Equipment Company,
55 Van Dam St., New York City.

APPLICABLE to airport and general shop use is a new first-aid kit—the Davis "Brac-Kit." Complete unit assembled in two baked enamel steel cases, one of which may be permanently wall-mounted, the other portable. Space available for ten complete first-aid units, contents of which may be made up to the requirements of any particular user, for any type of industrial hazard. Literature on request.

AVIATION, *December, 1935*

PARTS — **Ball Bearings**

Norma-Hoffmann Bearings Corporation,
Stamford, Conn.

A NEW line of self-lubricated precision bearings of the single-row, fully enclosed type designated as the "3,000" series. Sealing is effective and permanent but end plates are easily removable for inspection and cleaning. Bearings are handled as complete, self-contained cartridges at all times. May be furnished with or without filling plug for renewal of grease. Bearings now available are in the medium series, starting with the 25 m/m bore.
available.

AVIATION, *December, 1935*

PARTS — **Self-Tapping Screws**

Shakeproof Lock Washer Co.,
Chicago, Ill.

NEW catalogue received covering line of self-tapping bolts and screws, with wide application for joining sheet metal, die-cast or moulded parts. No tapping of holes required as screws are provided with a machine slot so that each cuts its own thread. Available in sizes from No. 4-40 to $\frac{3}{8}$-16. Flat and round heads are standard but oval, hexagonal washer or filister heads available on special order. Special types of screws may be made up with the self-tapping feature to order.

AVIATION, *December, 1935*

RADIO — **Head Phones**

The Brush Development Company,
1892 East 40th St., Cleveland, Ohio

A NON-MAGNETIC head phone for aircraft use announced. Driving elements of phones are piezo electrical crystals which are unaffected by proximity of any magnetic field. Phones respond to frequencies from 60 to 10,000 cycles. Operate from any normal source. Handle excessive volume without overload or diaphragm chatter. Complete information available on request.

AVIATION, *December, 1935*

SHOP EQUIPMENT — **Metal Shears**

Niagara Machine & Tool Works,
637 Northland Ave., Buffalo, N. Y.

THE series F foot-operated Niagara shear is designed primarily for cutting 16 gage and under sheet steel. Special feature for foot operated shears is a steel hold-down manually operated by self-locking eccentrics. Shears come completely equipped with knives, back, front, side, and bevel-gages. Available in cutting lengths from 36 to 72 in. for 16 gage, also in 8 and 10 ft. cutting lengths for 18 gage.

AVIATION, *December, 1935*

SHOP EQUIPMENT — **Welding Timer**

Welding Timer Corporation,
Chrysler Building, New York City, N. Y.

TO take care of extreme accuracy of control required for spot welding aluminum and other alloys, the No. 1, 2 and 3 Welco timers handle currents ranging from 30 to 250 amp. Vacuum tube timing control permits reliable operation down to $\frac{1}{2}$ cycle intervals, and can also be made to provide timing periods of one or more seconds with an accuracy of plus or minus 5 per cent. Literature available on request.

AVIATION, *December, 1935*

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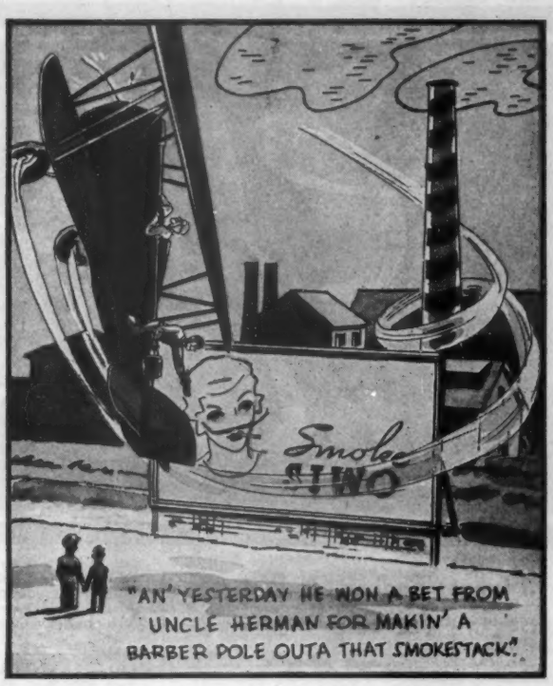

The gentleman in the above picture never flew in the Lafayette Escadrille or made Richtofen green with envy. But we happen to know that this fellow goes over his ship from stem to stern long before the usual 300 flying hours are up. No weakness escapes his eagle eye . . . if it did, he wouldn't be able to make barber poles out of smokestacks. ▸ Back in the days when 90 mph. was top speed, men learned that smooth, taut fuselage made for safety as well as speed, and Sherwin-Williams has kept step with aviation's finishing needs ever since, for fabrics, for woods, for metals. ▸ Ask the Key brothers, who set that 653 hour endurance record recently in the Ole Miss, what they think of S-W. Or Bennie Howard, who won the Bendix Trophy at the last Air Races. ▸ Today —because they're the best that can be made— S-W products are standard in factories, flying schools and private hangars everywhere.

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Opex Q-B Pigmented Dope	Gas Engine Enamels.
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Red Oxide Metal Primer	Opex Polishing Compound

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AMERICAN CIRRUS ENGINES and Parts. New. W. E. Berger, Menasco Manufacturing Company, 6714 McKinley Avenue, Los Angeles, California. No. 2

WRIGHT GYPSY ENGINES and Parts. New. R. J. Wenger, Menasco Manufacturing Company. 6714 McKinley Avenue, Los Angeles, California. No. 3

HISSO 150, 180 and 300-360 Engines and Parts. At ridiculously low prices. These make excellent speed boat engines when converted. Write for quotations on your requirements. Karl Ort, 609 W. Poplar St., York, Penna. No. 4

BULL PUP, Excellent Condition; motor majored 25 hours ago; total time, 225 hours. $400.00. George Laritz, c/o Boulevard Airport, Roosevelt Blvd. & Red Lion Rd., Philadelphia, Pa. No. 5

FAIRCHILD 22, Warner 125 H.P., Almost new, 60 hours total, sport landing gear, Wheel pants, Special paint job, Extras. F-S 295, Aviation, 330 West 42d St., New York City. No. 6

CONTINENTAL ROCKER ARM BALL BEARINGS replaced. New method. New Bearings, $3.50 per arm installed. Valve seats and guides and Bearings installed any motor quick service guaranteed, get our quotation. Most complete line of replacement parts specially in oversizes, 24 hours service. Air Transport Equipment, Inc., Garden City, N. Y. No. 7

WACO F, Kinner B5. Completely recovered. Engine overhauled this summer. Excellent condition. High gloss finish. F-S 296, Aviation, 330 West 42d St., New York City. No. 8

TRAVELAIR 6000B. Almost new, completely equipped, electric starter, generator, flares, lights, radio. Price $3,000.00. Frank Ambrose, Jackson Heights, N. Y. No. 9

WACO F2. Powered by Continental A70. No time since major overhaul. Aeroplane and Engine. Rubbed finish. Steel Prop. Chromium plated wire, etc. F-S 297, Aviation, 330 West 42d St., New York City. No. 10

STINSON S. Black and Silver, Leather upholstery—New Semi-Airwheels; Bank and turn, $1,750. Other ships for sale. 24-hour Charter Service. Approved Repair Station No. 47. Eastern Aeronautical Corp. Airport, Newark, N. J. No. 11

WACO F3 powered by Jacobs. 180 hours. Special leather upholstery. R.C.A. Radio. Wheel pants. Plated wires. Other extras. Privately owned. F-S 298, Aviation, 330 West 42d St., New York City. No. 12

REPAIRS—CONSULTATION—SALES—SERVICE—Pester Propeller Service, North Beach Airport, Jackson Heights, New York City. Telephones: Garden City 5768-M; HAvemeyer 4-9600. No. 13

MISCELLANEOUS EQUIPMENT. Dixie Magneto Switches, 49c.; Fuel Pressure Gauges, 47c.; Oil Pressure Gauges, 50c.; Engine Priming Pumps, 77c.; Distance Temperature Gauges, $1.98; Johns-Manville Tachometers, $5.87; Booster Magnetos, $4.95; Star Pathfinder Compasses, $12.87. Send dime for catalogue full of other bargains. Karl Ort, 607 W. Poplar St., York, Penna. No. 14

HUNDREDS OF AIRPLANE, Crackup, Motor Bargains. Ox jobs $100 up. Complete directory rushed for 20c, postpaid. Used Aircraft Directory, Athens, Ohio. No. 15

KINNER BIRD $1,200.00. Will take OX5 plane or Aeronca in trade. Liberal allowance on your used plane in trade on new Fairchilds. Free instructions to buyers. Private license. Solo time $3.00 per hour. Newhouse Flying Service, Princeton Airport, Princeton, N. J. No. 16

BOSCH BOOSTERS, new, $5.00. Wing spars and covers for all ships—very low prices on quality dopes and thinners. Air Transport Equipment, Inc., Garden City, N. Y. No. 17

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TAYLOR CUB, new September '34. 300 hours, motor just majored. $975. Simplex mid-wing monoplane, Kinner K-5 motor, unlicensed, $400. All ships in good flying condition. Clayton Lemon, P. O. Box 2144, Roanoke, Virginia. No. 19

LICENSED USED AIRPLANES $350 up. We may have just what you want. Call or send stamps for list. Pioneer Aircraft, c/o Airport, Syracuse, N. Y. No. 20

DOYLE: 2-place parasol. LeBlond 60. Licensed. 335 hours. Now being majored. Excellent condition. Air wheels, lights, compass, airspeed. $750 cash. Robert B. Taft, Charleston, South Carolina. No. 21

AMERICAN EAGLE, OXX-6-Scintilla Mag. Waco 10, rebuilt. Waco 10 parts. Velie parts. Aero Repair, 13210 French Road, Detroit, Mich. No. 22

J-5 CESSNA dismantled with motor as is, $375. Lyc. Stinson R. A-1 lots extras, $2,500. J-6-5 Waco—reconditioned, $1,175, ten other makes, trades considered. Omaha Aircraft Brokerage Service, South Omaha, Nebraska. No. 23

DAVIS, LeBlond 65, excellent condition, 293 hours, ship just overhauled and recovered. Licensed. $750 cash. Willis Kysor, Niles, Michigan. No. 24

CIRRUS Engines—English. Overhauled, in perfect condition. Complete list of used parts for Cirrus engines including many brand new parts. Lester J. Sipe, Box No. 118, York, Pa. No. 25

HEATH—single place, excellent condition, less than 100 hrs., priced to sell immediately. N.C. licensed to May. A. P. Bogus, 4538 S. California Ave., Chicago, Ill. No. 26

BELLANCA SKYROCKET. In A-1 condition. Equipped with wheel pants and radio. License just renewed. A good buy. Western Light & Telephone Company, Huron Bldg., Kansas City, Kansas. No. 27

WACO TEN, licensed to September, 1936, Hamilton prop, good condition, $450.00. Roland Ziegler, 934 E. Pacific St., Appleton, Wis. No. 28

NEW CESSNA C-34 now on display. When in Cleveland stop at Sundorph Aeronautical Corp., Cleveland Airport. We are Cessna distributors. No. 29

FAIRCHILD 24 Cirrus Cabin; never cracked up, dual control, new motor, 25 hours, steel prop, ship time 380 hours. Descomb, Crystal Drive, Wethersfield, Conn. No. 30

MONOPREP—Velie, just majored, wing and tail recovered ready to fly away. Jack Remsen, 78 Parkhurst St., Newark, N. J. No. 31

WACO 10, licensed to April, 1936, $295.00 cash if taken at once. Ludvig Tweten, Box 1293, Minot, No. Dak. No. 32

WACO J-5, equipped starter, position lights, aerol landing struts, brakes, metal prop, licensed Sept., 1936. Priced for quick sale, $1,150. Kenneth Joseph, West Chester, Ohio. No. 33

1933 CONTINENTAL WACO C. Total time 335 hours. Only 50 hours on engine since factory overhaul. Extra equipment: Lear radio, landing lights, electric starter and generator, bank and turn, rate of climb, and air brakes. Finish in good condition. Price $2,900. C. L. Burdick, duPont Building, Wilmington, Delaware. No. 34

J-5 cylinders reconditioned $12.50 each; with valves, springs and rocker boxes, $17.50 each; with springs, rocker boxes and both new valves, $22.50 each. General Airmotive, Municipal Airport, Cleveland, Ohio. No. 35

WACO F Warner; dual control, brake; licensed to July, 1936. Privately owned. Total time 500 hours; motor majored. C. Descomb, Crystal Drive, Wethersfield, Conn. No. 36

WACO C: Late 1933; 210 Continental. Total time 235 hours, 35 since top overhaul. Equipped with starter, brakes, airwheels, pants, airbrakes, dual wheel, etc. Finished gray, with silver wings and like new in every respect. $2,900 for quick sale. Stinson Reliant: 1934 model; total time 365 hours, 100 hours since complete major overhaul; painted black with red trim, equipped with landing lights, flares, excellent radio, 75-gallon tanks, rate of climb, turn and bank, thermocouple; special leather upholstery, etc. Like new in every respect. $3,600 for quick sale. R. D. Morgan, Air Service, Inc., Bellanca Field, New Castle, Delaware. No. 37

TRI-MOTOR STINSON, Model SM6000 B Mail. Fully equipped for night flying, including radio. Plane and motors in good condition. Price, $2,350. Stinson Lycoming SM8A in good condition, Standard equipment including motor driven generator, battery, electric starter and lights. Price, $1,350. Sampson Held, No. 6 Hangar, Floyd Bennett Field, B'klyn, N. Y. No. 38

TAYLOR CUB with Aeromarine motor giving exceptional performance. Plane and motor in excellent condition, 300 hours. Winter enclosure, compass and bank indicator, $875.00. Fairchild 22 with Cirrus Hi-drive, $1,200. Just overhauled and relicensed. K. Russell Smith, 394 Wyoming Ave., Wyoming, Pa. No. 39

STINSON-LYCOMING SM8A. Excellent cond. Refinished less than 1 yr. ago. 100 hrs. since motor majored. Battery and tires less than 1 yr. old, full air wheels, red leather upholstery. Turn and bank. Compass recently overhauled, wonderful buy for $1,500. Chas. Boye, 199 Genesee Ave., Warren, Ohio. No. 40

USED PARTS for Waco F and Warner motor: Instruments; air starter. Write for quotations on your needs. The H. C. Robbins Company, Cleveland Airport, Cleveland, Ohio. No. 41

REARWIN airplanes, new, used; OXX-6 Travel Air, Siemans Waco all licensed. General Air Service, 4500 W. 83rd St., Chicago, Ill. No. 42

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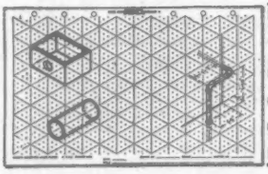

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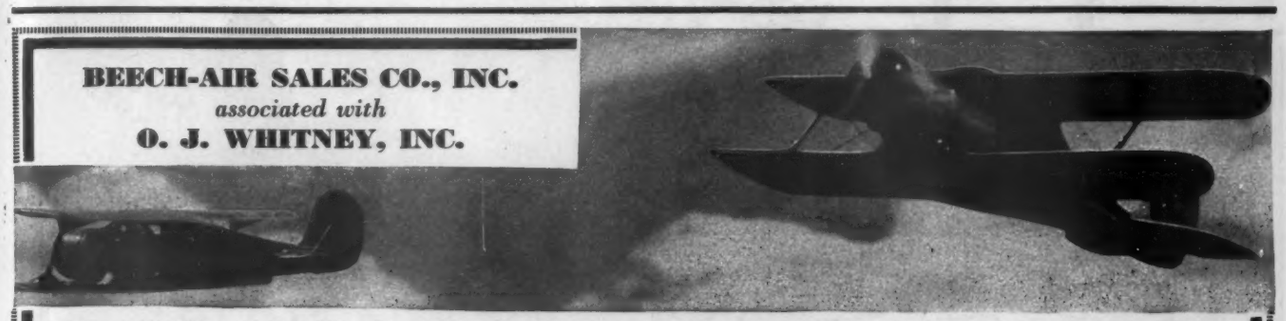

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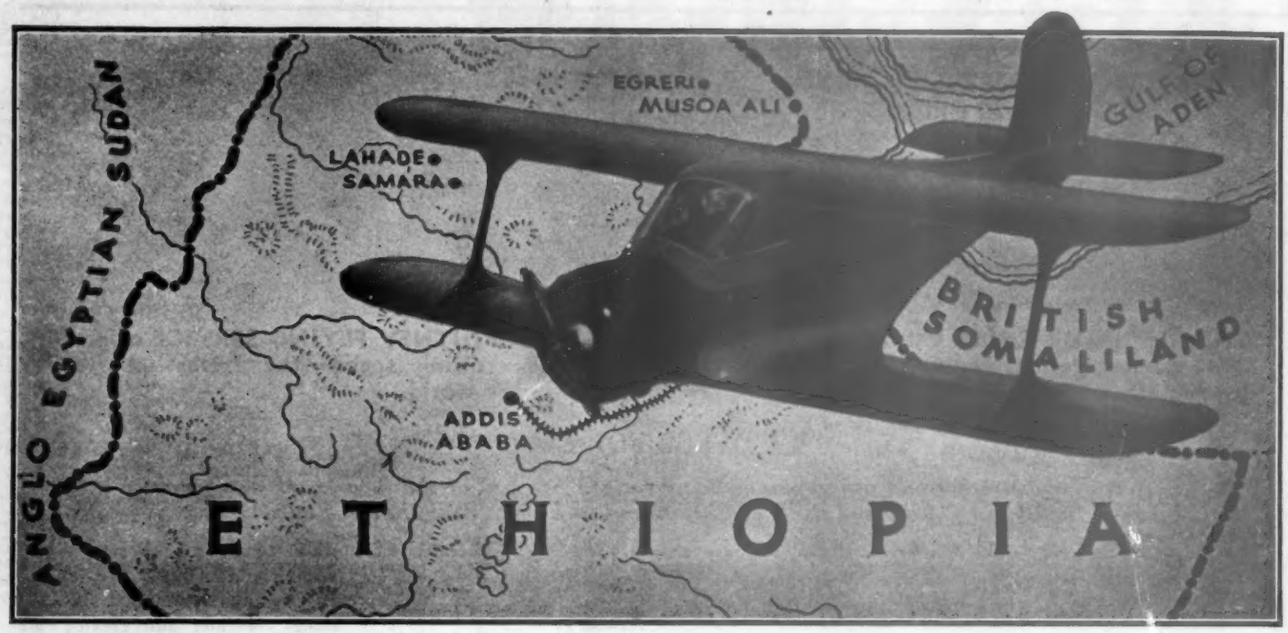

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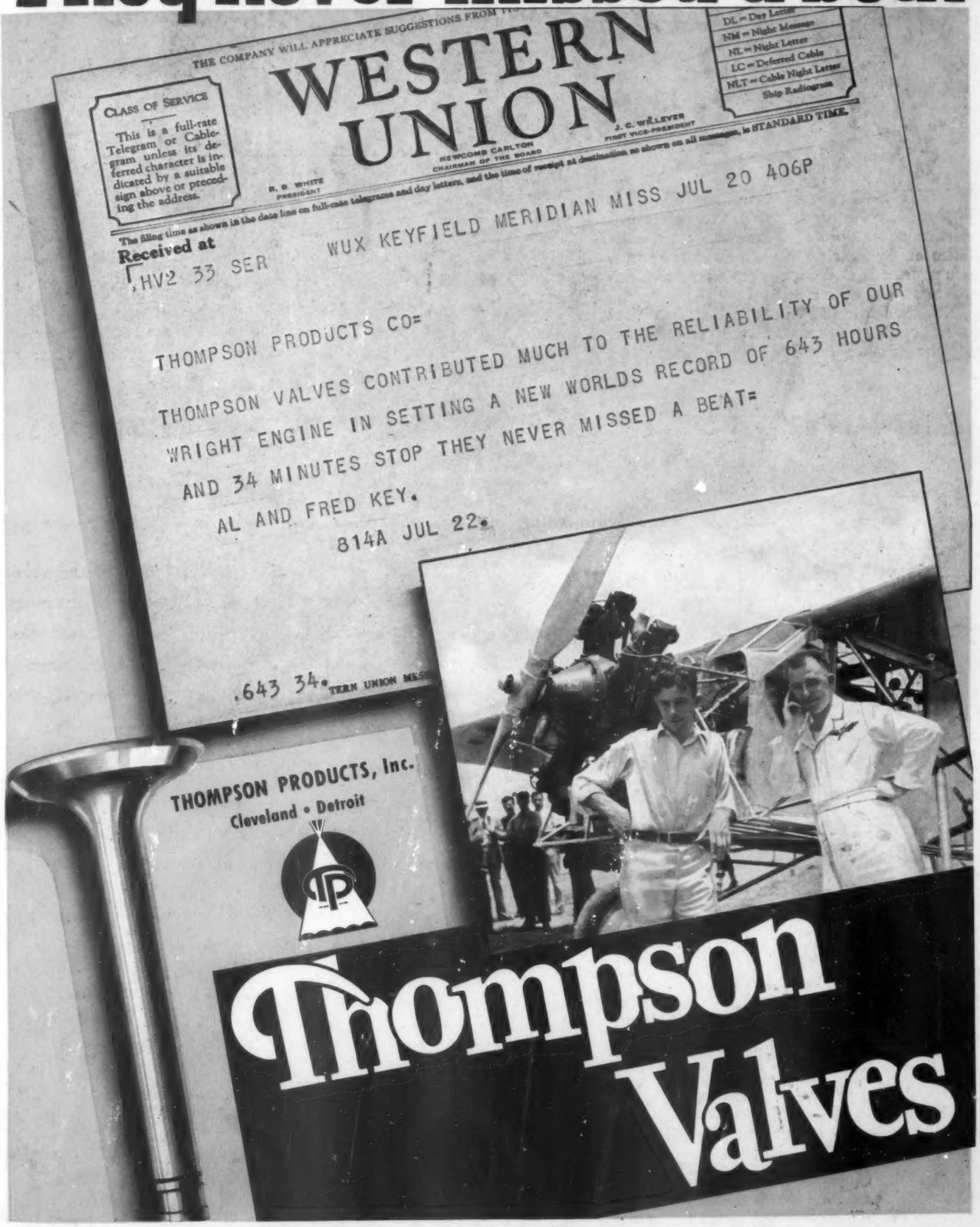
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The filing time as shown in the date line on full-rate telegrams and day letters, and the time of receipt at destination as shown on all messages, is STANDARD TIME.
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THOMPSON PRODUCTS CO=
THOMPSON VALVES CONTRIBUTED MUCH TO THE RELIABILITY OF OUR WRIGHT ENGINE IN SETTING A NEW WORLDS RECORD OF 643 HOURS AND 34 MINUTES STOP THEY NEVER MISSED A BEAT=
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THOMPSON PRODUCTS, Inc.
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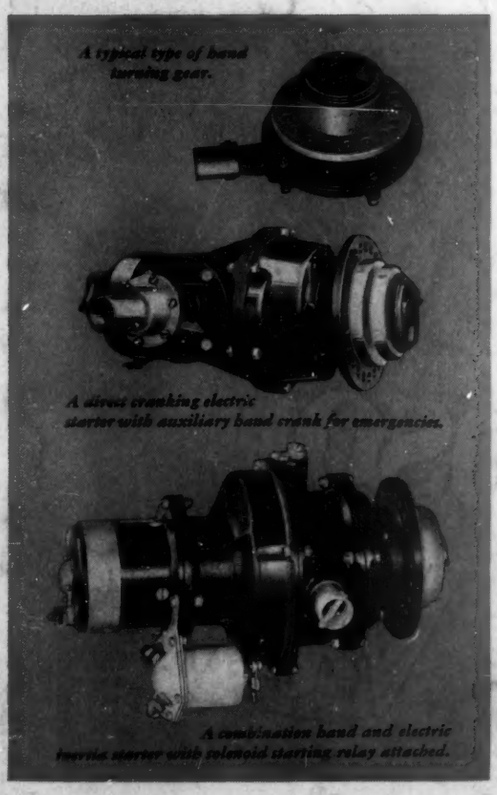
Confidence starts with starting ...when it's *Eclipse Starting!*

NOTHING associated with flying builds more confidence than a sure, swift start. Airline passengers and air service students alike enjoy hearing the engines roar into life promptly and without reluctance. Confidence *starts* with starting!

Eclipse Engine Starters handle this critical job for every American transport airline, for the Army, Navy and Marine Corps, and for most civilian aircraft. Whatever the type of Eclipse Starter employed—whether Hand Inertia, Direct Cranking, Electric, Combination Hand and Electric Inertia, Hand Turning Gears with and without Integral Booster Magneto, or Air Injection—Eclipse Starter equipment has the vital requirement of absolute reliability.

If the engine is in starting condition, Eclipse will start it.

ECLIPSE AVIATION CORPORATION
EAST ORANGE, N. J.
(Subsidiary of Bendix Aviation Corporation)



A typical type of hand turning gear.

A direct cranking electric starter with auxiliary hand crank for emergencies.

A combination hand and electric inertia starter with solenoid starting relay attached.